A RE-EXAMINATION OF THE MECOPTEROID AND ORTHOPTEROID FOSSILS (INSECTA) FROM THE TRIASSIC BEDS AT DENMARK HILL, QUEENSLAND, WITH DESCRIPTIONS OF FURTHER SPECIMENS

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Summary

This paper interrelates the species of mecopteroid and orthopteroid insects (excluding Blattaria), described in the literature, from the Triassic beds at Denmark Hill, Queensland. The affinities of a number of the species are considered to be very different from those proposed in the original descriptions. A new genus of Planipennia and another of Gryllacrididae (Orthoptera) and a new species of Perlaria are described. The order Protorthoptera Tillyard is relegated to family rank within the suborder Eumecoptera.

Introduction

Tillyard published a number of papers (1916, 1917, 1918, 1919, 1922, 1923, 1926) dealing with the insect fauna of this horizon of the Triassic Ispwich Series. This paper attempts to interrelate the species of mecopteroid and orthopteroid insects scattered throughout his papers. A number of additional specimens has been obtained since Tillyard's last paper and descriptions of these are included. Some of them are from the original Dunstan Collection but others are of more recent collecting by the staff of the Geology Department, University of Queensland, and the author. Two of these latter specimens come from a slightly different horizon separated by three or four hundred yards from the original site. Both specimens, wings of rather large insects, are beautifully preserved, so that the horizon is worthy of further development in the future.

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Very few Mecoptera are recorded from these beds and Trichoptera have not previously been recognized, though one of the described species, *Stereochorista frustrata* Tillyard, belongs in that order. The order Paratrichoptera is considered as a family, Mesopsychidae, within the Eumecoptera and the Protomecoptera, as represented by *Archipanorpa* Tillyard from this bed, has doubtful mecopteroid affinities. There are representatives of only two families of Eumecoptera, the Mesopsychidae referred to above and the Mesochoristidae. The Mesochoristidae persist from the Upper Permian, but are represented here only by the type genus *Mesochorista* Tillyard. The Mesopsychidae, which have a peculiar development of costal veinlets, are considered as a derivative of the Upper Permian Belmotiidae, although they have only a simple CuA in the forewing.

Four genera of Planipennia, here placed in two families, the Osmylopsychopidae and the Psychopsidae, were described by Tillyard. The latter family contains several Recent genera and is best developed in Australia. It is surprising that none of the Permian types of Neuroptera similar to those found at Belmont, New South Wales, have been described from these beds. However, in some of the unworked material uncovered at the original site, a species of *Archeosmylus* Riek does occur. At the new fossiliferous locality, a few hundred yards from the original site, which, however, is possibly not contemporaneous, another beautifully preserved osmylopsychopid has been discovered.

The orthopteroid insects described from these beds are placed here in the orders Protorthoptera, Orthoptera, and Phasmodea. A consideration of the order Blattaria, which is also well represented, is not included in this paper. A species of Perlaria is described in this revision. This is the first record of Perlaria from Triassic beds in Australia though not the oldest record of the order. However, the species is considered congeneric with the one described by Tillyard from the Upper Permian of Belmont.

**Order MECOPTERA**

**Family MESOCHORISTIDAE**

**Genus MESOCHORISTA** Tillyard


Primitive Mecoptera, forewing with a 2-branched Sc, 4-branched Rs, and 6-branched M, branching of M sometimes reduced to 5. In the hindwing M is only 4-branched.

**MESOCHORISTA PROAVITA** Tillyard


*Type.*—No. 32a (F39231 of the Australian Museum Collection).

Counterpart No. 32b in the Dunstan Collection.
A second specimen (F39230 and counterpart F39271), in the Australian Museum, here referred to this species, shows overlapping fore and hindwings. In the forewing M is only 5-branched, with an extra fork on $M_2$ only, and in the hindwing M is only a 4-branched.

Tillyard’s figure of the type is accurate in most respects, but he omits the crossveins of the radial and median fields. Actually there are no crossveins from Sc to the costal margin. The lettering of his figure is not accurate as CuA is shown as the posterior branch of M.

**Family ORTHOPHLEBIIDAE**

There is a rather fragmentary specimen, F39232 in the Australian Museum Collection, which belongs to this family. The specimen lacks most of the basal and apical thirds and also the anal field. It preserves an extra fork on $R_2$, giving a 5-branched Rs, and an extra fork on $M_4$.

**Family MESOPSYCHIDAE** Tillyard

Tillyard (1919) based his order Paratrichoptera on the single genus here placed in this family. It has a simple CuA, unlooped anal veins, and differs from most Mecoptera only in the series of costal veinlets, so the order cannot be maintained and the family Mesopsychidae must be placed in the Eumecoptera.

The family Pseudopolycentropodidae, incorrectly assigned to the Paratrichoptera byMartynov (1927) has a very different structure and is in no way related to the Mesopsychidae. The family Liassophilidae (Tillyard 1933) differs in having 3A looped on to 2A and in all of the anals being longer. Martynov (1937) has placed many quite distinct forms in this order.

**Forewing**: Rs and M both 4-branched; Sc branched and with a series of costal veinlets, otherwise normal Mecoptera.

**Hindwing**: Similar to forewing but Sc shorter and with fewer veinlets, and without a distinct cubito-median Y-vein.

The slight crinkling of the wing membrane is rather similar to that seen in the Belmontiidae (Riek 1953) but the family differs from the Paramecoptera in the unforked nature of CuA in the forewing. The two families show further similarities in the presence of costal veinlets, very large cubito-median Y-vein, and almost identical structure of Cu and anals, except for the forked CuA.

**Genus MESOPSYCHE** Tillyard


Not only are the four genera of Tillyard regarded as synonymous but their respective type species are considered conspecific. The type species of *Mesopsyche* is based on a hindwing. *Triassopsyche* is here considered to be a forewing in the same genus. *Aristopsyche* is a more complete forewing; Tillyard's figure shows a true costal vein, which, however, is really the humeral crossvein and two other crossveins brought into chance alignment. The specimen shows the normal structure of CuA, with distinct crossveins to CuP and to M₃₄. *Neuropsyche* is based on another very incomplete hindwing. In *Mesopsyche*, Tillyard has shown CuA and CuP fused towards the base, but in reality the veins are brought together only through a buckling of the wing membrane. In *Triassopsyche* R₁ is forked near the apex. There is no evidence of a crossvein to R₂ as figured by Tillyard.

**Generic Diagnosis—Forewing:** Normal Mecoptera except for a series of costal veinlets; Rs and M both normally 4-branched; a distinct cubito-median Y-vein. Sometimes there are small end-twiggings on the branches of Rs.

**Hindwing:** Sc shorter than in the forewing; without a distinct cubito-median Y-vein.

**MESOPSYCHE TRIAREOLATA** Tillyard

*Plate 1, Fig. 1*


**Types.**—Types of all species in the Australian Museum, Sydney.

The above synonymy is based on an examination of the holotypes and three other specimens from the same beds and an almost perfect hindwing (C2247 and counterpart C2246, University of Queensland, Department of Geology Collection), with a length of 17 mm, from the new outcrop at Denmark Hill.

**INCERTAE SEDIS**

Suborder *PROTOMECOPTERA* Tillyard

Family *ARCHIPANORPIDAE* Tillyard

Genus *ARCHIPANORPA* Tillyard


Genotype *Archipanorpa magnifica* Tillyard, 1917, loc. cit.

**ARCHIPANORPA MAGNIFICA** Tillyard


**Types.**—Holotype No. 120a, paratype No. 106a, in the Queensland Geological Survey.
The affinities of this species are very doubtful. The presence of a free $C$ would seem to exclude it from the Mecoptera, or possibly even from the mecopteroid stock.

Order TRICHOPTERA

Family STEREOCHORISTIDAE Tillyard

Tillyard placed this family in the Mecoptera. However, the species on which he based the family is a trichopteron, showing a forked $CuA$ and, as an additional guide, with $R_{2+3}$ forking before $R_{4+5}$, which occurs commonly in Trichoptera. Tillyard’s figure and interpretation of the venation show the specimen upside down, the anterior border being interpreted as posterior, so that his $R_3$ to $M_{4b}$ should read $CuA_1$, $M_4$, $M_3$, $M_2$, $M_1$, $R_6$, $R_4$, $R_3$, $R_2$. The specimen is in a very crushed state, particularly over the anterior portion, and the apical half has been pushed over the basal slightly at the break of $R$ ($Cu_1$ of Tillyard), so that its affinities within the Trichoptera are doubtful and for that reason the Trichoptera of other Mesozoic beds have not been referred to it.

Genus STEREOCHORISTA Tillyard


Genotype *Stereochorista frustrata* Tillyard, 1919, op. cit.: 197.

**STEREOCHORISTA FRUSTRATA** Tillyard

Fig. 1

![Venation Diagram]

Fig. 1.—*Stereochorista frustrata* Tillyard. Free-hand drawing of the holotype.


**Type.**—No. 218 in the Queensland Geological Survey.

The figure is a free-hand drawing of the type. A rough hand drawing is included as a camera lucida was not available when the type was examined in the Queensland Geological Survey.
Order PLANIPENNIA
Family ARCHEOSMYLIDAE
Genus ARCHEOSMYLUS Riek

Genotype Archeosmylus pectinatus Riek, 1953, op. cit.: 86.

This genus was known previously from the Upper Permian at Belmont and from the Triassic at Mt. Crosby. A primitive neuropteran from these Denmark Hill beds is placed in the same genus. This specimen, F39249 of the Australian Museum, is rather fragmentary and not worthy of specific description, though the record of the family in this Triassic horizon is of interest.

Family OSMYLOPSYCHOPIDAE

The genera of this family have hitherto been considered in the Prohemerobiidae. Three of the described genera of Planipennia were placed in that family, though one was subsequently removed to the Psychopsidae (Tillyard 1922). Although very fragmentary, it seems best to place the latter in the Osmylopsychopidae. A new genus, described in this paper, is also placed in this family, making the fourth from these beds.

Genus PROTOPSYCHOPSIS Tillyard

Genotype Protopsychoopsis venosa Tillyard, 1917, op. cit.: 180.

PROTOPSYCHOPSIS VENOSA Tillyard

Type.—No. 160a in the Queensland Geological Survey.

A very fragmentary specimen preserving only the apical third of the wing (length 9.5 mm). Its relationships are problematical but it is best considered in the family Osmylopsychopidae.

Genus OSMYLOPSYCHOPS Tillyard

Genotype Osmylopsychops spilleriæ Tillyard, 1923, op. cit.: 497.

OSMYLOPSYCHOPS SPILLERAE Tillyard

Types.—Holotype No. 314a and paratype No. 283a in the Queensland Geological Survey.

Length of wing from Tillyard’s reproduction 40 mm. This species is based on two well-preserved fragments which show nearly the complete structure of the wing. Tillyard’s reconstruction of the shape of the wing may not be correct as the postero-apical margin is not preserved.
Genus PETROPSYCHOPS, gen. nov.

Genotype Petropsychops superba, sp. nov.

Osmylopsychopid preserving clearly the apical structure of Sc, R₁, and Rs with Sc fused to R₁ and no distinct “vena triplica”; R bent strongly away from Sc at its base; Rs arising almost basally; Cu diverging strongly from the Sc-R veins; M forming a pectinate series of many anterior branches occupying a large area of the wing. The median field is most distinctive.

The genus is not closely allied to any of those already recorded from these beds, but in basal structures it approaches most closely to Archepsychops Tillyard, a genus placed in the Psychopsidae. The peculiar structure of M recalls that seen in the Jurassic Kalligrammidae.

PETROPSYCHOPS SUPERBA, sp. nov.

Plate 1, Fig. 2

Forewing: Almost complete except for apex and posterior margin; costal space moderately expanded, decreasing gradually towards the apex; Sc strong, fused to R₁ at its apex; R₁ diverging strongly from Sc at the base, strong, connected to Sc by spaced crossveins; Rs arising almost from base of R, immediately giving off a series of pectinate branches which, however, still show the dichotomic nature of their origin and form only a small angle with the stem of Rs; the more basad branches fork well before the middle, rather close to their origins; stems of M running parallel and close to CuA, giving off a large series of anteriorly directed pectinate branches which run almost parallel to the branches of Rs, so that without their basal attachments they would be considered as branches of that vein; CuA a very strong vein, diverging markedly from Sc, with a lower series of straight pectinate branches over its lower half; CuP arising almost basally and with several branches; several parallel branches to the anal veins. Length of specimen, along R₁, 28 mm.

Type.—Holotype C2136 and counterpart C2135 in the University of Queensland, Department of Geology Collection.

Type Locality.—Denmark Hill, near top of Ipswich series, Triassic. There is only the beautifully preserved holotype specimen.

Genus ARCHEPSYCHOPS Tillyard


Genotype Archepsychops triassica Tillyard, 1919, op. cit.: 206.

ARCHEPSYCHOPS TRIASSICA Tillyard


Type.—No. 137a in the Queensland Geological Survey.

Tillyard first placed this genus in the Prohemerobiidae but subsequently (1922) removed it to the Psychopsidae. Its basal structures are
very different from those of *Triassopsychops* Tillyard of the Psychopsidae and, although the costal space is extremely wide near the base, it narrows markedly towards the apex. It seems best to place it in the Osmylopsychopsidae.

**Family PSYCHOPSIDAE**

**Subfamily TRIASSOPSYCHOPINAE** Tillyard

**Genus TRIASSOPSYCHOPS** Tillyard


Genotype *Triassopsychops superba* Tillyard, 1922, op cit.: 469.

**TRIASSOPSYCHOPS SUPERBA** Tillyard


**Type.**—No. 284a in the Queensland Geological Survey.

Length of fragment 29 mm, indicating a total length of about 32 mm. This species differs from the other Ipswich Neuroptera in the structure of *Sc, R₁*, and *Rs* (forming a true "vena triplica"), and in the basal structure of *CuA*.

**Order PROTORTHOPTERA**

**Family MESORTHOPTERIDAE** Tillyard


**MESORTHOPTERON LOCUSTOIDES** Tillyard

Plate 2, Fig. 1


**Types.**—No. 5a and 5b in the Queensland Geological Survey. 5c does not belong (as stated by Tillyard 1922).

There are a number of additional specimens: Nos. 258b, 72a-b, 75, 78a-b, 123, 224, 234, and 241b in the Queensland Geological Survey; and, in the Australian Museum, F39242 preserving all but the analis and the apical third of the wing, and F39235 preserving only the apex.

The pectinate branches on *CuA* are distinctive. Many of the fragmentary specimens are associated, in part, on the primitive archedictyon.

**Order ORTHOPTERA (SALTATORIA)**

**Family LOCUSTOPSIDAE** Handlirsch

**Genus TRIASSOLOCUSTA** Tillyard


Genotype *Triassolocusta leptoptera* Tillyard, 1922, loc. cit.

This is the oldest genus of the family which is known also from the Liassic and Jurassic (Zeuner 1939).
**Triassolocusta leptoptera** Tillyard


_Type._—Holotype No. 99 in the Queensland Geological Survey.

The stem of _Cu_ and the anal s are not preserved. There is a crossvein from _M₃₄_ at its closest point to _Cu_, just after the forking of _M₁₂_. _M₄_ possibly shows a small terminal fork.

Family **Triassomantidae** Tillyard

Genus **Triassomantis** Tillyard


Genotype _Triassomantis pygmaeus_ Tillyard, 1922, loc. cit.

**Triassomantis pygmaeus** Tillyard

Type._—Holotype No. 86a in the Queensland Geological Survey.

The holotype differs somewhat from the text-figure given by Tillyard. The costal margin is straight, with a short _C_ preserving only the apical half. The stem of _Cu_ is not preserved but there is a fracture along that line. There are fewer apical forks to the vein designated as _M_ with _M₃_ and _M₄_ remaining simple and _M₂_ possibly so. There are fewer anterior branches to _R₃_, possibly only two.

The relationship seems to be with the Geinitziidae and not at all with the Mantodea.

Family **Gryllacrididae**

Subfamily **Proparagryllacridinae**, subfam. nov.

Differing from Recent Gryllacrididae in the origin of _M_ and in the fusion between _M_ and _Cu_. _M_ arising from the stem of _R_ close to the base; stem of _M_ fused with upper branch of _Cu_, with _M_ forking distally after becoming free from _Cu_.

Genus **Proparagryllacris**, gen. nov.

Genotype _Proparagryllacris crassifemur_, sp. nov.

**Forewing:** Wing fragmentary, only discally preserved; with the characters enumerated above; branching of the veins similar to that of the Recent _Paragryllacris_, with _M_ and _Cu_ each 2-branched and with portions of these veins fused.

**Proparagryllacris crassifemur**, sp. nov.

Plate 2, Fig. 3; Figs. 2-3

**Forewing:** Costa only partly preserved; _Sc_ with a distal upward curvature, with at least two anterior branches; _R_ diverging somewhat from
Sc after the origin of Rs; apical portions of R and Rs not preserved; M arising from the stem of R close to the base, fused to Cu almost immediately, becoming free well before the origin of Rs, forking after the origin of Rs; basal origin of Cu not preserved, forking before the origin of M, upper branch fused to the stem of M just after its origin, lower branch (?CuP) remaining simple; 1A, 2A, and 3A widely separated basally, converging distad.

*Proparagryllacris crassifemur*, sp. nov.

Fig. 2.—F39251, holotype, × c. 3.

Fig. 3.—C2134, paratype, × c. 3.

**Hindleg:** Femur large and basally expanded; tibia at least as long as the femur, its apex not preserved.

**Types.**—Holotype F39251, preserving portions of two wings, pronotum, and hindleg, in the Australian Museum Collection. Paratype C2134 in the University of Queensland, Department of Geology Collection. The paratype is more fragmentary than the type but preserves the anterior branches of Sc and the forking of M (length of fragment 16 mm).

**Type Locality.**—Dunstan Bed, Denmark Hill, Ipswich Series, Triassic.

The specimens, though fragmentary, preserve the essential basal structures, so that there can be no confusion of the species.

**Order PERLARIA**

**Family EUSTHENIIDAE**

Tillyard (1935) placed the genus *Stenoperlidium* Tillyard, originally recorded from the Permian of Belmont, in this family on a combination of wing venation and larval characters. A second species, described in this paper, shows additional primitive characters, but it is considered best to retain the genus within this family.

**Genus STENOPERLIDUIUM** Tillyard


*Stenoperlidium* Tillyard, 1935, op. cit.: 386.

Genotype *Stenoperlidium permianum* Tillyard, 1935, op. cit.: 387.

*Stenoperlidium* is considered as a possible synonym of *Antitaxineura* which was described in the Odonata, family Polytaxineuridae. *Antitaxi-
neura is based on such a fragmentary specimen that it is best considered a nomen dubium and the name *Stenoperlidiurn* retained for this genus of Perlaria.

**Forewing**: Very narrow, not particularly narrowed basally; *Sc* rather short, ending a little beyond half-way in a short fork connecting with both *C* and *R*₁; costal veinlets only moderately well developed; *R* strongly built, *Rs* with a series of 4 pectinate branches distally; *M* 2-branched, forking just before half-way; *CuA* a strong vein divided into 3 distally; a strong crossvein from *CuA* to the stem of *M*; *CuP* unbranched.

**STENOPERLIDIUM TRIASSICUM**, sp. nov.

Plate 2, Fig. 2; Figs. 4-5

*Stenoperlidiurn triassicum*, sp. nov.

Fig. 4.—C2244, holotype, × c. 3.

Fig. 5.—F39256, paratype, × c. 3.

**Forewing**: Almost complete, length 27 mm, lacking most of anal veins, extreme base and apex not clearly preserved; *Sc* ending a little beyond half-way in a short fork connecting with both *C* and *R*₁ and touching *R*₁ just before a strong crossvein from *Rs*; crossveins from *Sc* to the costal border limited in number; *R*₁ strong, not clearly preserved in the pterostigmatic region; *Rs* 4-branched, arising at about one-fourth, gently convexed to *R*₁ as far as the end of *Sc* and there connected to *R*₁ by a strong crossvein, then diverging from *R*₁ again before branching; base of *M* not preserved (wing slightly crumpled); *M* 2-branched, the upper branch deflected towards *Rs* and connected to it by a strong crossvein at the level of the end of *Sc*; basal origin of *Cu* not preserved, stem forking early, a strong crossvein from *M* close to its origin to *CuA* close to its origin; the crossvein runs postero-distally, in a direction opposite to the cubito-median crossveins; *CuA* branches very close to its apex, 3-branched, with *CuA₁* strongly arched towards *M*, *CuA₂* arising almost at the wing margin and only slightly arched away from the margin, *CuA₃* extremely short, continuing the direct line of *CuA* to the wing margin; *CuP* a weak vein, almost parallel to *CuA*; 1A only partly preserved, a strong simple vein; other anals not preserved; distinct oblique crossveins running in different directions between *M* and *CuA* and between *CuA* and *CuP*.

**Type**.—Holotype C2244 and counterpart C2245 in the University of Queensland, Department of Geology Collection.
Type Locality.—New outcrop, Denmark Hill, near top of Ipswich Series, Triassic.

There is a second specimen, F39256 in the Australian Museum Collection from the Dunstan locality, preserving the apical third of a wing. In this specimen Sc ends a little earlier, the branching of Rs differs in detail and the apical branching of CuA is more distinct. The apex is slightly more rounded. In all probability it is the apex of a hindwing.

This species can be distinguished by the branching of CuA, the shape of the stem of Rs, and the more angled M$_{1+2}$. It is close to the genotype and preserves more of the basal structure of the wing, particularly the forking of Cu and the cubito-median Y-vein, which shows clearly the direction of the median arm.

Order PHASMODEA

The family Aeroplanidae placed by Tillyard (1918) in a distinct suborder Aeroplanoptera of the Protodonata is considered to fall within this order. Martynov (1928) also considers this family in the Phasmodea. He places the Aeroplanidae, the Necrophasmidae, the Aerophasmidae, and the Chresmodidae in the suborder Chresmododea.

Suborder CHRESMODODEA

Family AEROPLANIDAE Tillyard

Genus AEROPLANA Tillyard


Genotype Aeroplana mirabilis Tillyard, 1918, loc. cit.

AEROPLANA MIRABILIS Tillyard


Type.—Holotype No. 126a in the Queensland Geological Survey.

This species shows a very primitive condition, with a well-developed forewing, apparently as long as the hindwing. The anal fan of the hindwing is very imperfectly preserved but it can be seen on the lower side of the holotype specimen.

This is the oldest representative of the order. The Necrophasmidae and the Aerophasmidae are from the Upper Liassic of Turkestan and the Chresmodidae are from the Upper Jurassic of Bavaria and England.

INCERTAE SEDIS

Genus MESOMANTIDION Tillyard


Genotype Mesomantidion queenslandicum Tillyard 1916, loc. cit.
Mesomantidion queenslandicum Tillyard


Type.—Holotype 1a in the Queensland Geological Survey, 1b (counter-part) in the Dunstan Collection.

This is not considered to be an insect, but if it is, its relationships are very problematical.

References


Fig. 1.—*Mesopsyche triareolata* Tillyard, hindwing, C2247. $\times c.7$.
Fig. 2.—*Petropsychops superba*, gen. et sp. nov., holotype, C2136. $\times c.4$.

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Fig. 1.—Mesorthopteron locustoides Tillyard, F39242. × c. 5.
Fig. 2.—Stenoperlidium triassicum, sp. nov., holotype. C2244. × c. 4.
Fig. 3.—Proparagryllacris crassifemur, gen. et sp. nov., paratype, C2134. × c. 6.

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