

ON THE AFFINITIES OF THE GRYLLOBLATTIDÆ

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The family Grylloblattidæ includes two known genera viz. *Grylloblatta* Walk. (N. America) and *Galloisiana* Caudell (Japan). In its morphological characters it is evidently the most primitive living family of Orthopterous insects. Viewed from the phylogenetic standpoint, the Grylloblattidæ are of exceptional interest in that they combine features of the Orthoptera (*sensu lat.*) Isoptera, Dermaptera and Embioptera. Most of these characters have already been pointed out by Walker (1914) and in a series of papers by Crampton. The possession of a combination of "synthetic" characters, that are exhibited also in other groups, has rendered it difficult to settle the taxonomic position of the Grylloblattidæ and the affinities of the latter have consequently given rise to some divergence of opinion. In so far as the main characters are concerned, Walker considered that they are nearest allied to the family Blattidæ of the Orthoptera Cursoria. The present writer (1925) also maintained that the Grylloblattidæ are more closely related to the Cursoria than to the Saltatoria. On the other hand, Crampton in his most recent publication (1926) on the subject emphasises his previous opinion that the family should be placed along with the Orthoptera Saltatoria. In endeavouring to clear up the cause of this bone of contention it is useful to enumerate the principal characters that distinguish these two main divisions of the old order Orthoptera and they are summarised below.

ORTHOPTERA CURSORIA. (Blattidæ and Mantidæ, together with the more distantly related Phasmidæ). Legs usually of approximately equal size and the hind pair not modified for leaping: tarsi 5-jointed. Sound producing organs wanting. Cerci most often multiarticulate, often with 8 to 15 or more joints. Ovipositor reduced and concealed. Penis asymmetrical.

ORTHOPTERA SALTATORIA (Orthoptera *sensu stricto*: Acridiidæ, Tettigoniidæ and Gryllidæ). Legs of unequal size,

the hind pair modified for leaping: tarsi never more than 4-jointed. Sound producing organs almost always present. Cerci never multiarticulate. Ovipositor well developed and almost always exerted. Penis bilobed and symmetrical.

On the characters enumerated above it may be said that the Grylloblattidæ only differ from the Cursoria in the possession of a well developed exerted ovipositor. It is, however, necessary to examine certain other criteria and not base a definite conclusion solely upon this diagnosis. Furthermore, several of the features stressed by Crampton in maintaining his point of view need some comment.

(1) Absence of ocelli. This character is of little phylogenetic value as ocelli tend to degenerate or disappear in various Orthoptera. Thus, among the Cursoria they are reduced or wanting in some apterous Blattidæ as well as being absent in many Phasmidæ. Their absence, therefore, is no criterion of affinity with the Saltatoria.

2; Multiarticulate cerci only occur in the Blattidæ and the related family Mantidæ. Unjointed setiform cerci are found in the Gryllidæ but there is no indication that this superficial similarity to the same, but multiarticulate, organs in the Grylloblattidæ is anything more than a parallelism, induced perhaps, by a similar terrestrial life.

(3) Dr. Crampton has already pointed out the structural similarity that exists between the terminal abdominal segments of the Grylloblattidæ and Mantidæ. He has likewise stressed the similarity of the coxæ, trochanters and divided trochantins, as seen in the Grylloblattidæ and Blattidæ, so no further comment here is needed.

(4) The various Isopteran characters displayed in the Grylloblattidæ, and emphasised by Crampton, afford indirect support to the relationship of that family with the Blattidæ. It is generally accepted by such competent authorities as Holmgren and others that the Isoptera are closest related to the Blattidæ on the sum total of their characters. Evidences of affinity of the Grylloblattidæ with the Dermaptera and Embioptera have very little bearing upon their systematic position within the Orthoptera.

(5) The Saltatorial affinities of the family are undoubted as Walker was the first to demonstrate. My contention is that they are insufficient to warrant its transference from the Cursoria. The most important character is the exerted ovipositor of the Tettigonid type but here, as Walker has shown, it is constructed on a somewhat more primitive plan. The presence of the vaginal orifice between sterna 8 and 9 affords another character of the Saltatoria but is it also shared with the Phasmidæ. The general resemblance of the head to that of the Gryllidæ has been pointed out by Walker and subsequently by Crampton. The antennæ, on the other hand, show no such affinity and are definitely Embiid in character. The mouth-parts yield no decisive data although in some particulars they exhibit slight, but unconvincing, resemblances to those of the Gryllidæ.

(6) The full evidence of internal anatomy is at present unavailable but when Miss Ford's study of this aspect is completed we shall be in possession of data of considerable importance. Her recent study of the abdominal muscles (1924), however, indicates that the Grylloblattidæ betray Blattid and Mantid relationships rather than affinities with the Saltatoria.

In conclusion, it is hoped that the present article sufficiently explains the grounds for including the Grylloblattidæ as a family of the group Cursoria of the Orthoptera (*sensu lat.*) I wish to thank thank Miss Norma Ford for kindly supplying me with a well preserved example of the species *Grylloblatta campodeiformis*.

LITERATURE.

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