STUDIES ON THE FEMALE COPULATORY ARMATURE OF SIX PYRGOMORPH GENERA (PYRGOMORPHIDAE: ACRIDOIDEA: ORTHOPTERA)

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The female genital armature, which comprises the egg-guide, postvaginal sclerites, the columellae, the tunic and external opening of the vagina are most developed in Caelifera rather than in Ensifera. The evolution of the female genital armature is considered to be correlated with the structure of the male genitalia in these groups. In Caelifera the male epiphallus depresses the female genital plate and thereby aids in intromission of the penis. In Ensifera, on the other hand, the intromittent penis is lacking and therefore the subgenital plate is a simple flap-like structure.

The male genitalia of insects in general have long been used by taxonomists in classification but Randell (1963) was the first to initiate the study of female copulatory armature from a taxonomic point of view.

Randell (*l.c.*) made a preliminary survey of the female copulatory structures in the suborder Caelifera and indicated the correlation of various types of epiphalli with the postvaginal sclerites and relative prominence of the egg-guide. He also asserted that when the male epiphallus is plate-shaped, the postvaginal sclerite is also similar and the egg-guide is poorly developed, whereas in those groups in which the epiphallus is bridge-shaped, the postvaginal sclerites are divided into two lateral areas and the egg-guide is well developed.

The present work is of exploratory nature and attempts preliminary studies on the female copulatory armature, in association with the male epiphallus, of six pyrgomorph genera *viz. Pyrgomorpha, Chrotogonus, Atractomorpha, Peokilocerus, Sphenarium* and *Zonocerus*. The subgenital plate and epiphallus of each genus is drawn on the same scale. It is intended to advance this work further by examining representative types of other Orthoptera *s. str.* so as to assess the validity of Randell's (1963) contention.

The female copulatory armature is located on the subgenital plate (seventh sternum) posterior to the vaginal opening. It consists of fine serrations on the posterior margins of the subgenital plate, particularly in the vicinity of the egg-guide (Eg). The posterior border of the subgenital plate is nearly straight to gently

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rounded. The postvaginal sclerite (Pvg) forms an inflection on the internal surface of the subgenital plate and is divided in two plates which are joined with each other at their postero-mesal surface by a V-shaped semi-sclerotic area, the ovitract (Ot) which is continuous anteriorly with the tunic (Tn.) A narrow groove is formed between the arms of the ovitract. The anterior margin of the postvaginal sclerites are covered over partly by crescent-shaped membrane, the tunic (Tn), and partly by the external opening of the vagina which has its long axis in the horizontal plane. The postvaginal sclerites are joined to the external surface of the subgenital plate by a pair of small sclerites, the columellae (Cm). The ovitract extends as far as the base of the egg-guide (Eg.). The latter is a triangular, plate-like structure protecting posteriorly from the mid-posterior margin of the subgenital plate.

The epiphallus is a strongly sclerotized structure and is located on the dorsal surface of the ectophallus. It is bridge-shaped and is composed of lateral plates (LP) which are connected with one another by a narrow median plate, the bridge (B). The lateral plates carry a pair of antero-lateral projections (AP). A pair of hook-like processes, the lophi (L)-posterior projections of Dirsh (1956), are located on the posterior margins of the lateral plates. A pair of elongated club-shaped structures (A)-dorso-lateral appendices of Dirsh (*l.c.*), are situated close to the anterior projections. These are homologous with the oval sclerites of other acridoids. The ancorae are absent.

In *Pyrgomorpha* (Fig. 1) the posterior margin of the subgenital plate is slightly rounded and bears minute serrations along its inner halves. The postvaginal sclerites (Pvg) are large and almost oval in shape. The ovitract (Ot) is narrow and reaches as far as the base of the egg-guide (Eg). The tunic (Tn) is sharply curved and narrow. The columellae (Cm) are rounded structures and are located in close proximity to the base of the egg-guide. The latter is small with narrow apex.

In *Pyrgomorpha* (Fig. 2) the bridge (B) of the epiphallus is wide and the lateral plates (LP) are expanded at base. The lophi (L) are strong, upcurved, laterally directed and with acute apices. The dorso-lateral appendices (A) are with strong stalks ending in broad apical lobes.

In *Atractomorpha* (Fig. 3) the posterior margin of subgenital plate is rounded and smooth; without serrations. The postvaginal sclerites (Pvg) are narrow and oval in shape. The ovitract (Ot) is small and narrow, extending into basal part of the egg-guide. The tunic (Tn) is wide and feebly curved. The columellae (Cm) are rounded and are located at the base of the egg-guide (Eg) but not attached to it. The egg-guide is large but with a wide apex.

The epiphallus of *Atractomorpha* (Fig. 4) presents much variation. Its bridge (B) is very wide and extends as far as the posterior parts of the lateral plates (LP)

and together with the lophi (L) forms an anchor-like structure. The lateral plates are narrow. The lophi are lobe-like, antero-laterally directed and with obtuse apices. The dorso-lateral appendices (A) are strong with broad apical lobes.

In *Chrotogonus* (Fig. 5) the posterior margin of the subgenital plate is almost straight and its serrations do not extend farther than one-third of the plate. The postvaginal sclerites (Pvg) are large and oval in shape. The ovitract (Ot) is large and wide. The tunic (Tn) is sharply curved but wide. The columellae (Cm) are marginal and elongate. These are attached to the proximal parts of the egg-guide (Eg) which is large with narrow elongate apical part.

The epiphallus of *Chrotogonus* (Fig. 6) has narrower bridge (B) with externo-lateral expansions of lateral plates (LP) also smaller. The lophi (L) are long, slender but upcurved and laterally directed. Their apices are more acute. The dorso-lateral appendices (A) are with weaker stalks and narrow apical lobes.

In *Poekilocerus* (Fig. 7) the posterior margin of the subgenital plate is nearly straight. Its serrations extend up to two-third part of the plate. The postvaginal sclerites (Pvg) are large and oval in shape. The ovitract (Ot) is large but very narrow. The tunic (Tn) is wide but not sharply curved. The columellae (Cm) are almost marginal, elongate and triangular in shape. These are located on either side of the proximal parts of the egg-guide (Eg) and are attached to it. The egg-guide is a wide triangular plate with a short and narrow apex.

The bridge (B) of the epiphallus in *Poekilocerus* (Fig. 8) is proportionately narrow and the lateral plates (LP) lack externo-lateral expansions. The lophi (L) are upcurved but directed anteriorly and their apices less acute than those of the above genera. The dorso-lateral appendices (A) are strong and with broad apical lobes.

In *Sphenarium* (Fig. 9) the posterior margins of the subgenital plate are somewhat truncated and bear minute serrations along their inner halves. The postvaginal sclerites (Pvg) are small and almost oblong. The ovitract (Ot) is wide but small and extends into the basal part of the egg-guide (Eg). The tunic (Tn) is sharply curved and narrow. The columellae (Cm) are elongated structures and extend almost full length of the posterior margin of the subgenital plate. The egg-guide (Eg) is triangular with acute apex.

The bridge (B) of the epiphallus of *Sphenarium* (Fig. 10) is longer than broad and the lateral plates (LP) possess narrow externo-lateral expansions. The lophi (L) are strong, with truncated apices, upcurved and directed laterally. The dorso-lateral appendices (A) are also strong and with broad apical lobes which do not extend as far as the base of the lophi.

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In *Zonocerus* (Fig. 11) the posterior margin of the subgenital plate is slightly rounded and incurved towards the inner side and bears minute serrations along its median part. The postvaginal sclerites (Pvg) are narrow because of large size of the tunic and the ovitract and are almost rectangular. The ovitract (Ot) is large and wide and extends well within the basal part of the egg-guide. The tunic (Tn) is large and sharply curved along the middle. The columellae (Cm) are again elongated structures and extend three-fourth length of the posterior margin of the subgenital plate. The egg-guide (Eg) is triangular, much wide at the base but narrows down distally to subacute apex.

The epiphallus of *Zonocerus* (Fig.12) has somewhat wider bridge (B) which lacks median process. The lateral plates (LP) are wider at base but become narrow distally. The lophi (L) are upcurved, directed laterally and with acute apices. The dorso-lateral appendices (A) are strong, with broad apical lobes and diverge sharply from the lateral plates. Anterior projections (AP) are with obliquely truncated apices.

Randell (1963) has shown that "the at space between them [Columellae] varies in width to match the width between the lophi of the epiphallus." A comparison between the width of lophi of the epiphallus with that of columellae of post-vaginal sclerites, which has been assessed by overlaying the drawings of the male epiphallus over that of the subgenital plate (both drawn on the same scale), by measuring their width by a divider and also by overlaying the epiphallus itself over the subgenital plate, indicates that the width between the lophi far exceeds that of columellae in *Pyrgomorpha*, *Chrotogonus*, *Atractomorpha*, *Sphenarium* and *Zonocerus* but it does compare well in *Poekilocerus*, since in the former five genera the lophi are directed laterally whereas in the latter it points anteriorly. Besides the columellae are almost marginal and somewhat elongate in *Chrotogonus*, *Poekilocerus*, *Sphenarium* and *Zonocerus* whereas in *Pyrgomorpha* and *Atractomorpha* these are of the conventional type (rounded) and far removed anteriorly. The lophi are upcurved in all the genera examined and by virtue of their being terminal structures are best suited to rest against the depression of the tunic so as to bring about a firm hold of the postvaginal sclerites and depress the subgenital plate. It is further borne out by the fact that the epiphallus of *Atractomorpha* approaches more to the plate-like epiphalli of Pamphagidae and Pauliniidae which have similar female copulatory armature except that the columellae are absent. The posterior margin of epiphallus rests against the tunic. I, therefore, do not consider existence of any correlation between the lophi and the columellae in so far as the genera under discussion are concerned. I further consider that the groove formed by the arms of the ovitract acts as a real guide to the ova since the groove

is narrow to nearly narrow so as to accommodate only one egg at a time while on way to the exterior. The terminal triangular plate, the egg-guide appears to be accessory in function to the ovitract.

Pyrgomorpha, *Chrotogonus*, *Poekilocerus*, *Atractomorpha* and *Sphenarium* each represents the type genus of the tribes Pyrgomorphini, Chrotogonini, Poekilocerini, Atractomorphini and Sphenariini respectively whereas the *Zonocerus* falls into tribe Phymateini. The present studies also indicate that the female copulatory armature cannot be employed for taxonomic purposes at tribal or generic levels.

I. Explanation of Figures.

1. Subgenital plate of *Pyrgomorpha*.
2. Epiphallus of *Pyrgomorpha*.
3. Subgenital plate of *Atractomorpha*.
4. Epiphallus of *Atractomorpha*.
5. Subgenital plate of *Chrotogonus*.
6. Epiphallus of *Chrotogonus*.
7. Subgenital plate of *Poekilocerus*.
8. Epiphallus of *Poekilocerus*.
9. Subgenital plate of *Sphenarium*.
10. Epiphallus of *Sphenarium*.
11. Subgenital plate of *Zonocerus*.
12. Epiphallus of *Zonocerus*.

II. Abbreviations used in the Text.

A. Subgenital plate of the female.

Cm - Columella.
Eg - Egg-guide.
Ot - Ovitract.
Pvg - Postvaginal sclerite.
Sg - subgenital plate.
Tn - Tunic.
Vg - Vagina.

B. Epiphallus of the male.

A - Dorsolateral appendices.
AP - Anterior process.
B - Bridge.
L - Lophi.
LP - Lateral Plate.

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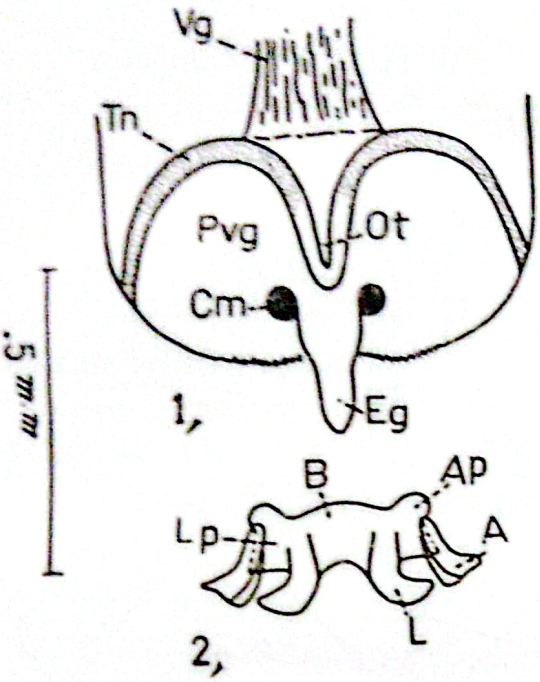
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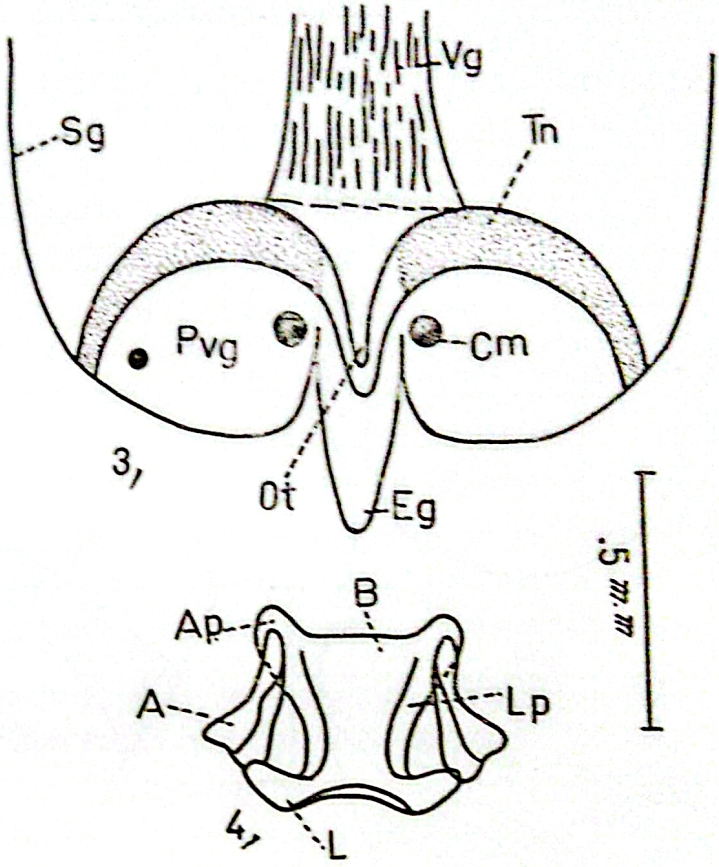
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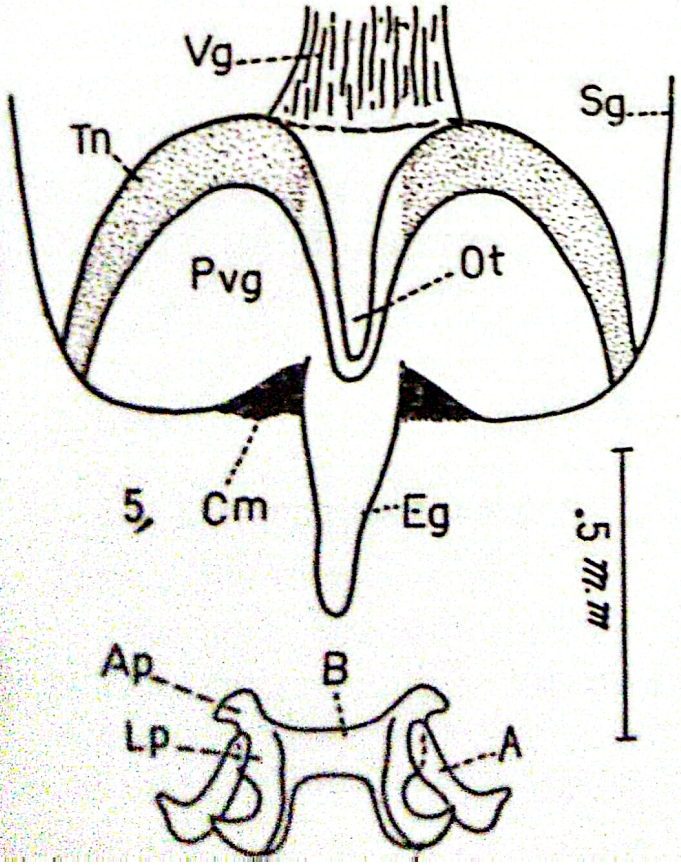
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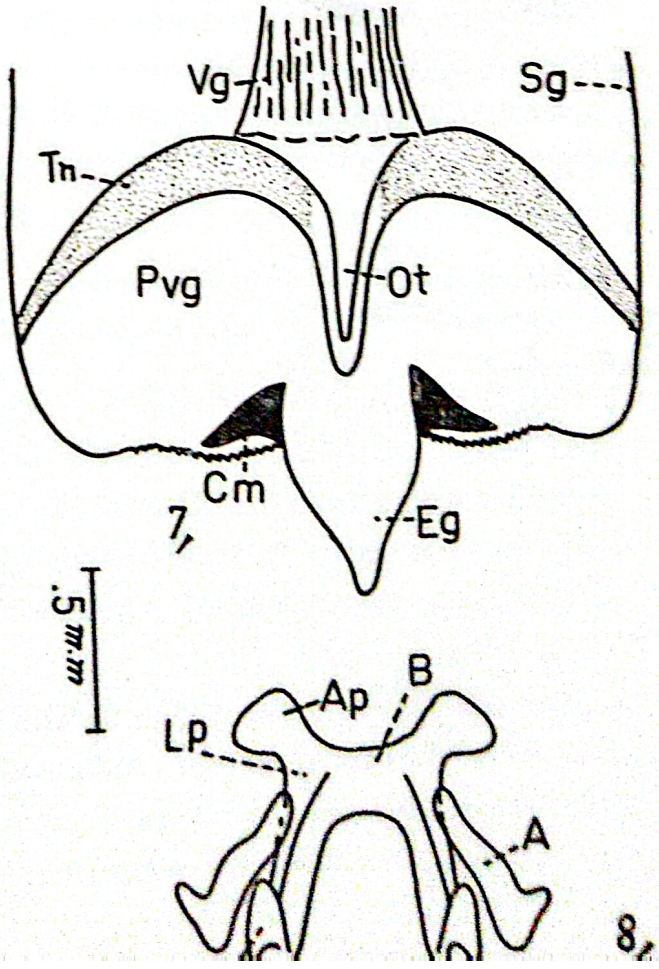
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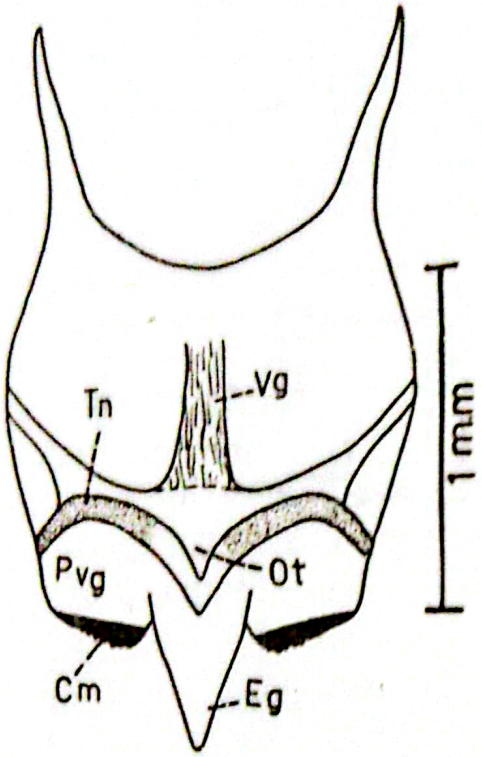
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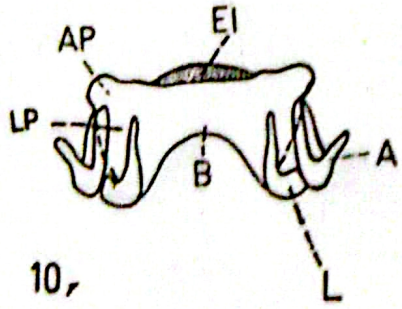

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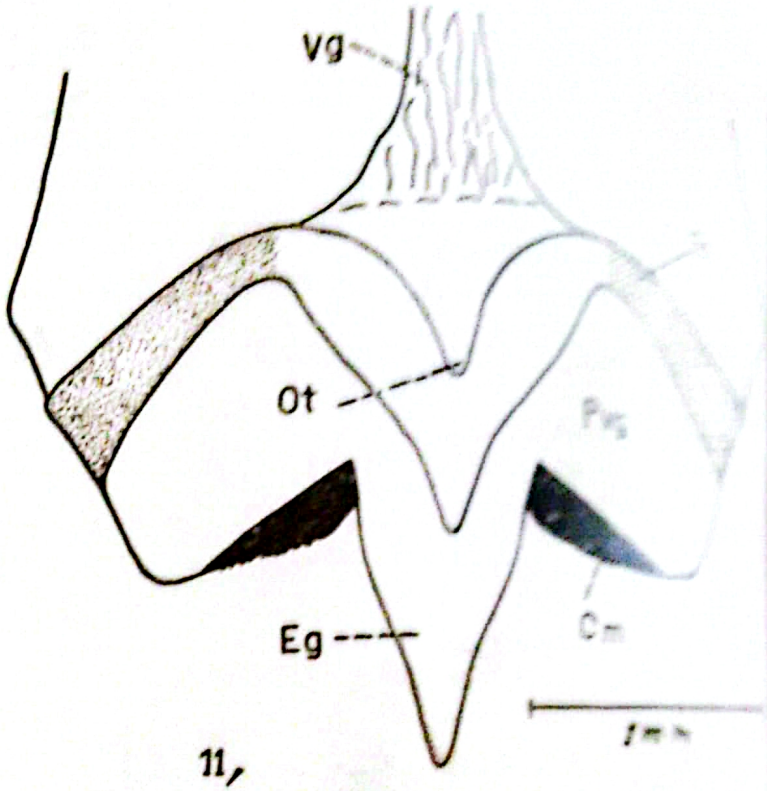

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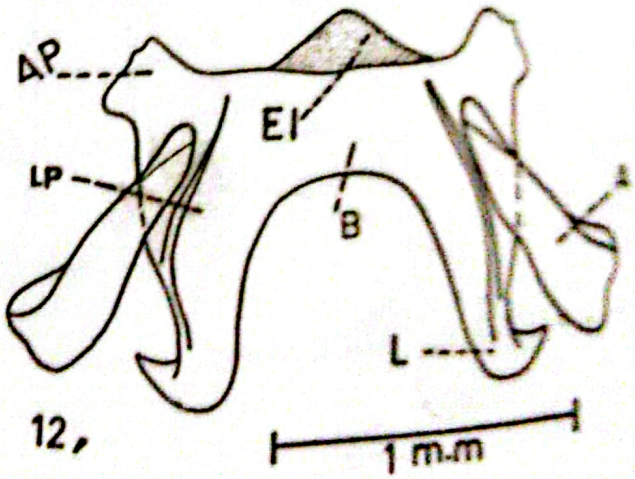
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