

TAXONOMIC SIGNIFICANCE OF THE MALE GENITALIA (EPIPHALLUS) OF SOME SPECIES OF SHORT-HORNED GRASSHOPPERS (ORTHOPTERA: ACRIDOIDEA)¹

PRASAD KUMAR AND C. A. VIRAKTMAHI²
(With forty-six text-figures)

Comparative study of epiphallus was made on 46 species representing 40 genera of short-horned grasshoppers, and its taxonomic significance is shown. Presence or absence of dorso-lateral appendices, ancorae, oval sclerites, shape and type of bridge, ancorae and lophi of epiphallus are considered as key characters.

INTRODUCTION

Even though short-horned grasshoppers are common insects, little attention has been paid to the study of their taxonomy. A comparative study of the male genitalia has been used for identification. With this objective in view the present study was undertaken to examine the morphology of epiphallus of some species of short-horned grasshoppers of Karnataka.

Chopard (1920) was the first to introduce the structure of the male genitalia in systematics. Since then genitalia have been used as supplementary characters for the identification of species and genera (Roberts 1941, Uvarov 1943, Dirsh 1956, Kevan and Singh 1964, Hollis 1965, 1971, 1975; Mason 1973, Ritchie 1981, 1982).

Roberts (1941) studied the male genitalia of some representatives of Acrididae for an understanding of the relationship of Acrididae to other groups of Orthoptera. Dirsh (1956) studied in more detail the phallic complex of the Acridoidea and made a change in the classification of the family Acrididae. Rattanal and Parshad (1959a, b) studied the male genitalia of certain Truxalinae and Acridinae.

MATERIAL AND METHODS

46 species under 40 genera were determined from the specimens collected from Ban-

galore district, Karnataka. The collected grasshoppers were identified by using pertinent literature. All identifications were later confirmed by Dr. S.K. Tandon and Dr. M.S. Shishodia, Zoological Survey of India, Calcutta.

The tip of the male abdomen was detached with the help of a microscissor and then transferred to a test tube containing a few millilitres of 10% potassium hydroxide. This was heated slowly till convection currents formed in the solution. The abdomen portion was removed to a cavity dish containing water and the digested soft tissues were pressed out with the help of bent needles. After repeated washing in water, the portion was transferred to glycerine in a cavity for removing the muscular tissues and separation of genitalic parts from the phallic complex.

The genitalia were dissected out under a stereoscopic microscope and the epiphallus transferred to a cavity slide containing a few drops of glycerine. Then illustrations were prepared using a compound microscope with a *camera lucida*. All the epiphalli were drawn from the dorsal aspect.

The terminology used in the present study is listed below and illustrated in Figs. 1 and 41. The abbreviations used are given in parentheses.

Ancorae (An): Paired hook-like structures on anterior of dorsal surface of epiphallus.

Anterior projections (Ap): Projecting anterior ends of lateral plates of epiphallus.

Bridge (Br): Middle part of epiphallus connecting its lateral parts.

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²Dept. of Entomology, University of Agricultural Sciences, GKVK Campus, Bangalore 560065.

Dorso-lateral appendices (DLa): Lobes connected with the dorso-lateral parts of anterior end of epiphallus.

Lophi (Lp): A pair of processes on or near posterior end of epiphallus.

Oval sclerites (Os): A pair of small sclerites, circular, oval or irregular in form, near sides of epiphallus.

Posterior projections (Pp): Posterior ends of lateral plates of epiphallus.

Phallic a complex: Comprising the whole phallic organ of epiphallus. There are three main types of epiphallus: bridge-shaped (Figs.1-15), with divided bridge (Figs.31-34) and plate-like (Fig.16)

RESULTS AND DISCUSSION

The epiphallus has a definite role in the taxonomy of short-horned grasshoppers. It has been used as a main character and also as a supporting character for separation of families, genera or species. The epiphallus in respect of 46 species presented are described (Figs. 1-46).

KEY TO FAMILIES OF ACRIDOIDEA (BASED ON EPIPHALLUS)

1. Epiphallus with dorso-lateral appendices; oval sclerites absent Pygromorphidae
- Epiphallus without dorso-lateral appendices; oval sclerites present Acrididae

I. Family: ACRIDIDAE

Epiphallus usually bridge-shaped, sometimes divided; with or without ancorae; lophi of variable shape; dorsolateral appendices absent; oval sclerites present.

a) Sub-family: Acridinae

Epiphallus bridge-shaped, sometimes with central protrusion; with ancorae and single or bilobed nodulated lophi.

1. *Acrida exaltata* (Walker) (Fig. 1)

Epiphallus with moderately broad median bridge, its anterior margin convex with small paired, bilobed, nodulated lophi and blunt, peg-

like ancorae.

2. *Acrotylus humbertianus* Saussure (Fig. 2)

Epiphallus with moderately wide bridge, narrow blunt end ancorae and bilobate lophi.

3. *Aiolophus thalassinus tamulus* (Fabricius) (Fig. 3)

Epiphallus with moderately narrow bridge, curved ancorae and bilobate lophi.

4. *Dittopternis venusta* (Walker) (Fig. 4)

Epiphallus with broad median bridge, ancorae broad based with rather pointed tips and bilobed lophi.

5. *Gastrimargus africanus africanus* (Saussure) (Fig. 5)

Epiphallus with comparatively large bridge, ancorae with blunt end and lophi bilobed. Ritchie (1982) used structure of lophi to distinguish the species of the genus *Gastrimargus*.

6. *Gelastorhinus semipictus* (Walker) (Fig. 6)

Epiphallus with moderately narrow bridge, comparatively large ancorae and small undivided lophi.

7. *Heteropternis respondens* (Walker) (Fig. 7)

Epiphallus with stout broad bridge, convex anteriorly and concave posteriorly, ancorae with somewhat pointed tips and bent inwards and bilobed nodulated lophi.

8. *Hilethera hierichonica* Uvarov (Fig. 8)

Epiphallus with narrow bridge and small, stout blunt end ancorae, anterior projection large and single lobed lophi.

9. *Locusta migratoria* (Linnaeus) (Fig. 9)

Epiphallus with moderately wide bridge, blunt end ancorae, anterior projections large and large bilobate lophi.

10. *Morphacris fasciata* Kirby (Fig. 10)

Epiphallus with narrow bridge, ancorae robust with blunt end, very large bilobate lophi.

11. *Oedaleus abruptus* (Thunberg) (Fig. 11)

Epiphallus rectangular with narrow bridge, ancorae broad based, slender, incurved apically with blunt end and lophi bilobate.

12. *Oedaleus senegalensis* (Krauss) (Fig. 12)

Epiphallus rectangular with narrow bridge,

ancorae slender, blunt end bilobate lophi. Ritchie (1981) used structure of bridge as a supporting character for separation of species of the genus *Oedaleus*.

13. **Phlaeoba panteli** Bolivar (Fig.13)

Epiphallus with narrow bridge, narrow ancorae with rounded apex, anterior projections rounded and small single lobed lophi.

14. **Sphingonotus savignyi** Saussure (Fig.14)

Epiphallus rectangular with moderately narrow bridge, ancorae large with subacute apex and bilobed lophi.

15. **Trilophidia annulata** (Thunberg) (Fig.15)

Epiphallus with narrow bridge, ancorae short with rounded apices, lophi large and bilobed and posterior lobes with a shallow excavation. Hollis (1965) separated this species from *T. conturbata* and *T. cinnabarina* on the basis of epiphallus.

b) Subfamily: Calliptaminae

Epiphallus plate-like, with ancorae and without lophi.

1. **Caloptenopsis insignis** (Walker) (Fig.16)

Epiphallus plate-like, with rather rectangular, small ancorae and without lophi.

c) Subfamily: Catantopinae

Epiphallus bridge-shaped; ancorae mostly present; lophi of variable form.

1. **Catantops karnyi** Kirby (Fig.17)

Epiphallus bridge-shaped with incurved blunt end, small ancorae and lobiform lophi.

2. **C. pinguis innotabilis** (Walker) (Fig.18)

Epiphallus bridge-shaped with large incurved, rather pointed ancorae, anterior projections large and small lobiform lophi.

3. **C. pulchellus** (Walker) (Fig.19)

Epiphallus bridge-shaped, with small incurved, rounded end ancorae and large lobiform lophi.

4. **Xenocatantops** sp. (Fig.20)

Epiphallus with wide bridge, ancorae incurved with subacute apex and large lobiform lophi.

d) Subfamily: Coptacridinae

Epiphallus bridge-shaped, with divided bridge, ancorae and lobiform lophi present.

1. **Epistaurus sinetyi** Bolivar (Fig.21)

Epiphallus with divided bridge, small blunt end ancorae and large lobiform lophi.

2. **Eucoptacrella praemorsa** (Stal) (Fig.22)

Epiphallus with divided bridge, ancorae with pointed apices and wide lobiform lophi.

e) Subfamily: Cyrtacanthacridinae

Epiphallus robust, bridge-shaped, with small or without ancorae; lophi large, lobiform.

1. **Anacridium flavescens** (Fabricius) (Fig.23)

Epiphallus robust, bridge shaped, large, elongate, lobiform lophi and without ancorae.

2. **Cyrtacanthacris tatarica** (Linnaeus) (Fig.24)

Epiphallus with elongate, narrow lobiform lophi, without ancorae and with large anterior projections.

3. **Nomadacris succincta** (Johanson) (Fig.25)

Epiphallus with wide bridge, small ancorae and large lobiform lophi.

f) Subfamily: Eyprepocnemidinae

Epiphallus bridge-shaped, mostly with poorly sclerotised bridge; curved ancorae and large lophi present.

1. **Eyprepocnemis alacris alacris** (Serville) (Fig. 26)

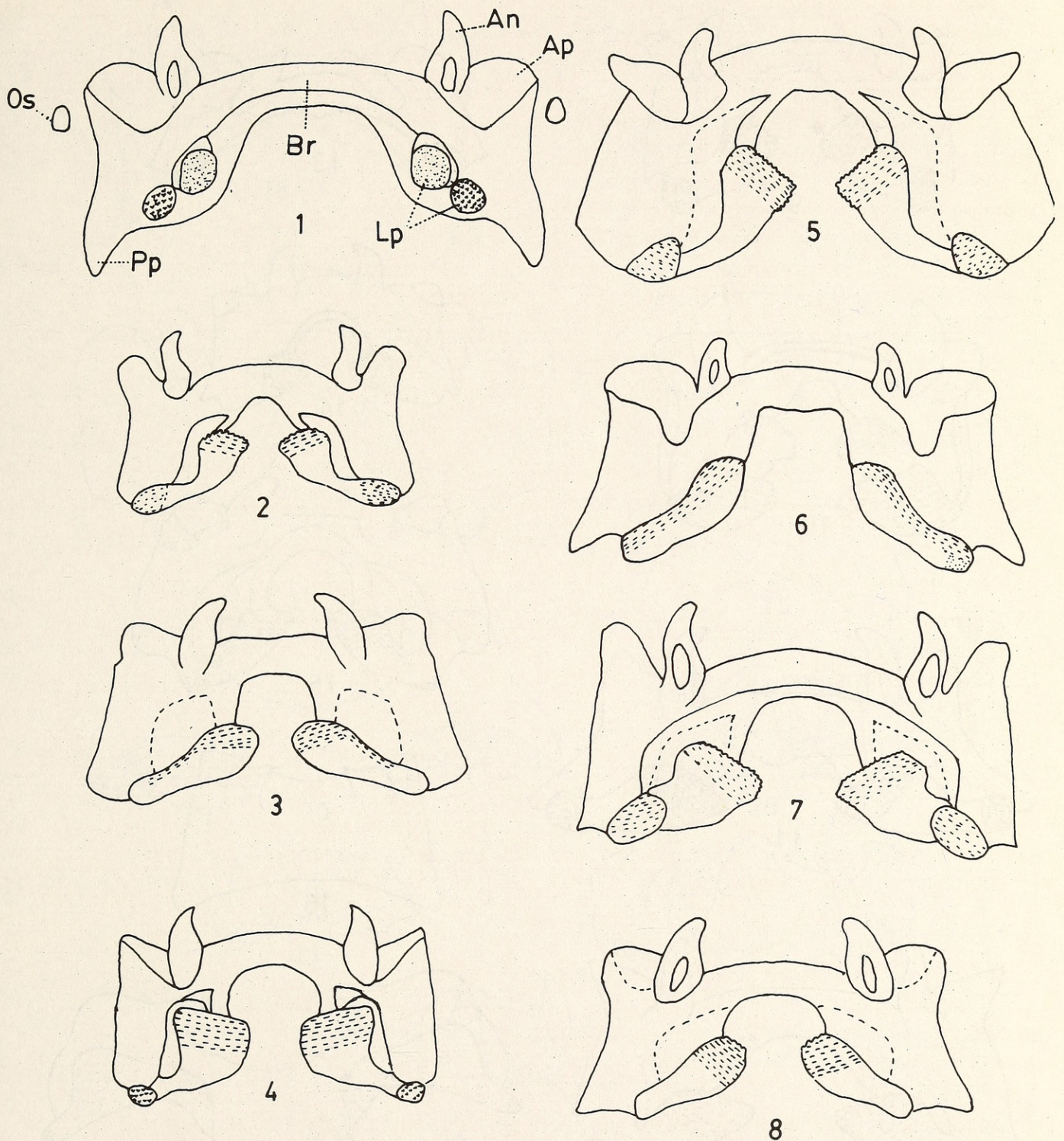
Epiphallus with narrow bridge, moderately large incurved ancorae with sub-acute apex and obtuse angular lophi.

2. **Tylotropidius varicornis** (Walker) (Fig.27)

Epiphallus bridge-shaped, ancorae well developed, curved missally and rather rectangular, large lophi.

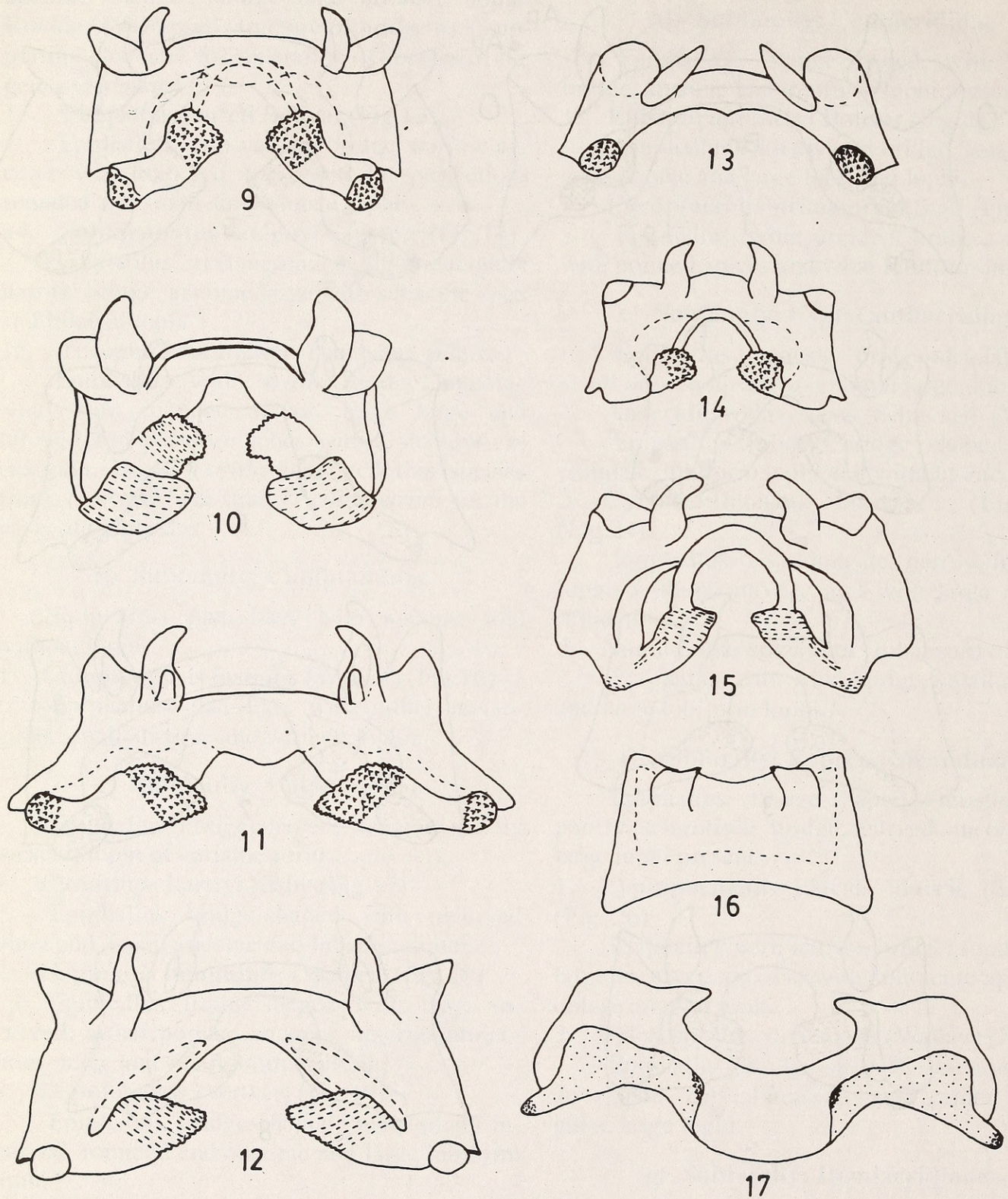
g) Subfamily: Hemiacridinae

Epiphallus bridge-shaped, sometimes with divided bridge; ancorae present; lophi of variable form.



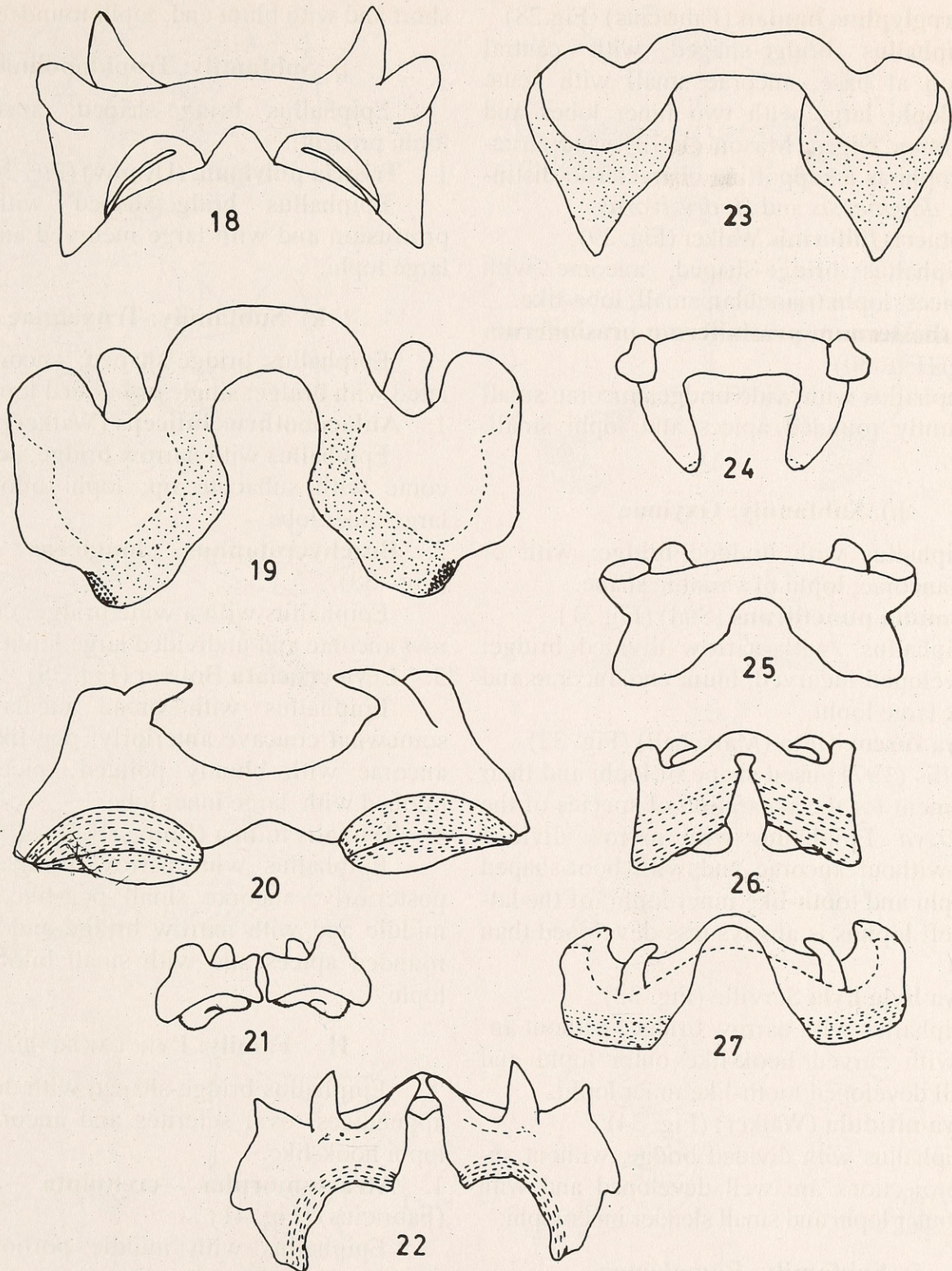
Figs. 1-8. Epiphallus in dorsal view

1. *Acrida exaltata*, 2. *Acrotylus humbertianus*, 3. *Aiolopus thalassinus tamulus*, 4. *Dittopternis venusta*,
 5. *Gastrimargus africanus africanus*, 6. *Gelastorhinus semipictus*, 7. *Heteropternis respondens*, 8. *Hilethera hierichonica*.



Figs. 9-17. Epiphallus in dorsal view

9. *Locusta migratoria*, 10. *Morphacris fasciata*, 11. *Oedaleus abruptus*, 12. *Oedaleus senegalensis*, 13. *Phlaeoba panteli*,
 14. *Sphingonotus savignyi*, 15. *Trilophidia annulata*, 16. *Caloptenopsis insignis*, 17. *Catantops karnyi*.



Figs. 18-27. Epiphallus in dorsal view

18. *Catantops pingus innotabilis*, 19. *Catantops pulchellus*, 20. *Xenocatantops* sp., 21. *Epistaurus sinetyi*,
 22. *Eucoptacra praemorsa*, 23. *Anacridium flavescens*, 24. *Cyrtacanthacris tatarica*, 25. *Nomadacris succincta*,
 26. *Eyprepocnemis alacris alacris*, 27. *Tylotropidius varicornis*.

1. **Hieroglyphus banian** (Fabricius) (Fig. 28)

Epiphallus bridge-shaped with central protrusion at base, ancorae small with acute apices; lophi large with two inner lobes and sinuate outer edges. Mason (1973) used structure of lophi as a supporting character to distinguish *H. daganensis* and *H. oryzivorus*.

2. **Leptacris filiformis** Walker (Fig. 29)

Epiphallus bridge-shaped, ancorae with acute apices, lophi triangular, small, lobe-like.

3. **Spathosternum prasiniferum prasiniferum** (Walker) (Fig. 30)

Epiphallus with wide bridge, ancorae small with bluntly rounded apices and lophi small, rounded.

h) Subfamily: Oxyinae

Epiphallus with divided bridge; with or without ancorae; lophi of variable shape.

1. **Gesonula punctifrons** (Stal) (Fig. 31)

Epiphallus with narrow divided bridge; well developed incurved, blunt end ancorae and complex large lophi.

2. **Oxya fuscovittata** (Marschall) (Fig. 32)

Hollis (1971) used shape of lophi and their development for the separation of species of the genus *Oxya*. Epiphallus with narrow divided bridge, without ancorae and with boot-shaped outer lophi and tooth-like inner lophi; of the latter the left lophus is always less developed than the right.

3. **Oxya hyla hyla** Serville (Fig. 33)

Epiphallus with narrow bridge; without ancorae, with curved hook-like outer lophi and with well developed tooth-like inner lophi.

4. **Oxya nitidula** (Walker) (Fig. 34)

Epiphallus with divided bridge, without ancorae, projections are well developed and with straight outer lophi and small slender inner lophi.

i) Subfamily: Romaleinae

Epiphallus robust, bridge-shaped, with short ancorae and lophi.

1. **Tetratodes monticollis** (Gray) (Fig. 35)

Epiphallus bridge shaped, robust; ancorae

short and with blunt end; lophi rounded.

j) Subfamily: Tropidopolinae

Epiphallus bridge-shaped; ancorae and lophi present.

1. **Tristria pulvinata** (Uvarov) (Fig. 36)

Epiphallus bridge-shaped with central protrusion and with large incurved ancorae and large lophi.

k) Subfamily: Truxalinae

Epiphallus bridge-shaped; ancorae articulated with bridge; single or bilobed lophi.

1. **Aulacobothrus luticeps** (Walker) (Fig. 37)

Epiphallus with narrow bridge; peg-like ancorae with subacute tip; lophi bilobed, with large inner lobe.

2. **Brachycrotaphus longiceps** (Bolivar) (Fig. 38)

Epiphallus with a wide bridge; curved narrow ancorae and undivided large lophi.

3. **Leva cruciata** Bolivar (Fig. 39)

Epiphallus with broad median bridge, somewhat concave anteriorly; peg-like hollow ancorae with bluntly pointed apices; lophi bilobed with large inner lobe.

4. **Truxalis indica** (Bolivar) (Fig. 40)

Epiphallus with narrow bridge, concave posteriorly; ancorae small peg-like, broad in middle and with narrow bridge and somewhat rounded apices and with small bilobed paired lophi.

II. Family: PYRGOMORPHIDAE

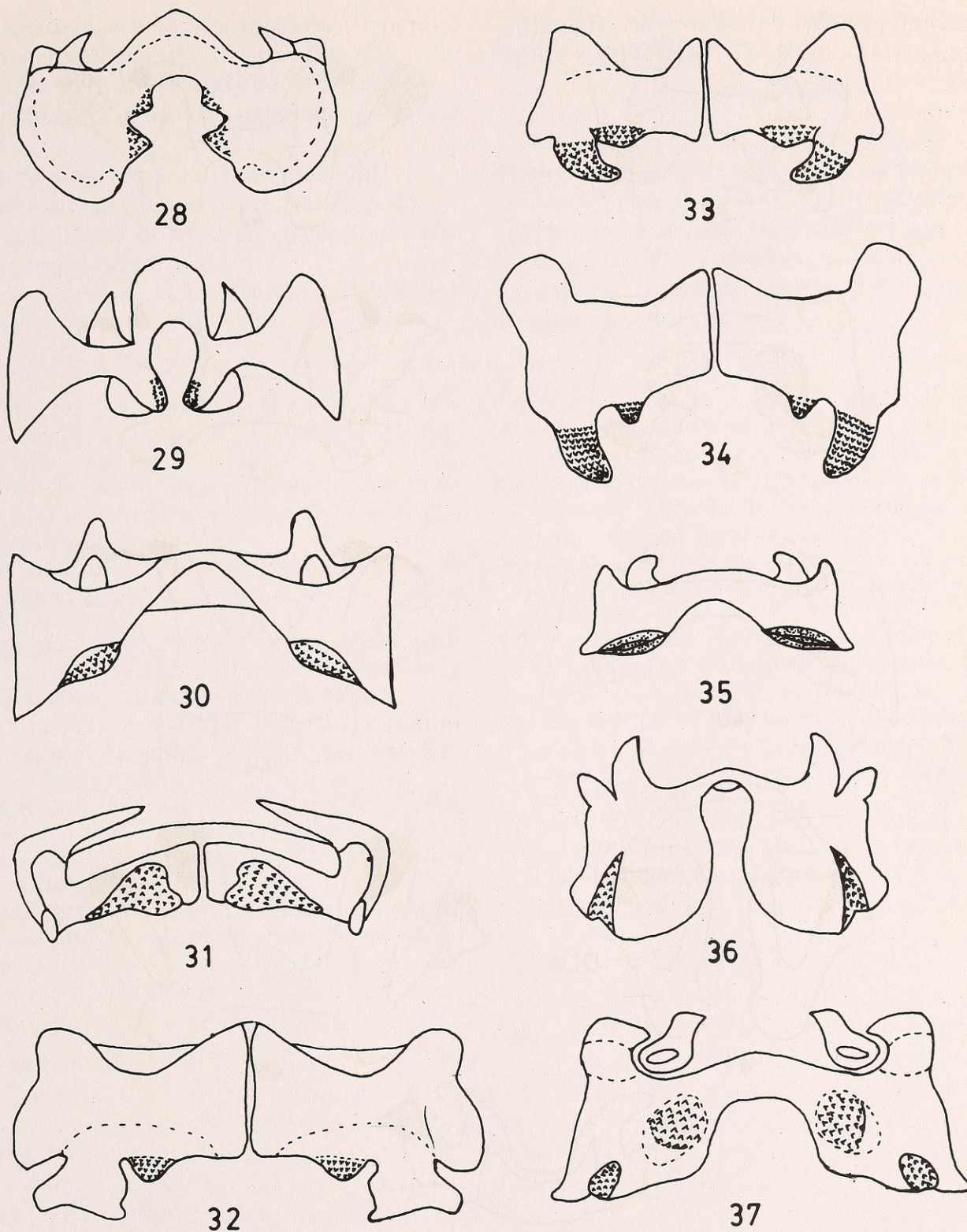
Epiphallus bridge-shaped with dorsolateral appendices; oval sclerites and ancorae absent; lophi hook-like.

1. **Atractomorpha crenulata crenulata** (Fabricius) (Fig. 41)

Epiphallus with middle portion anchor-shaped; dorsolateral appendices with small nodules on disc.

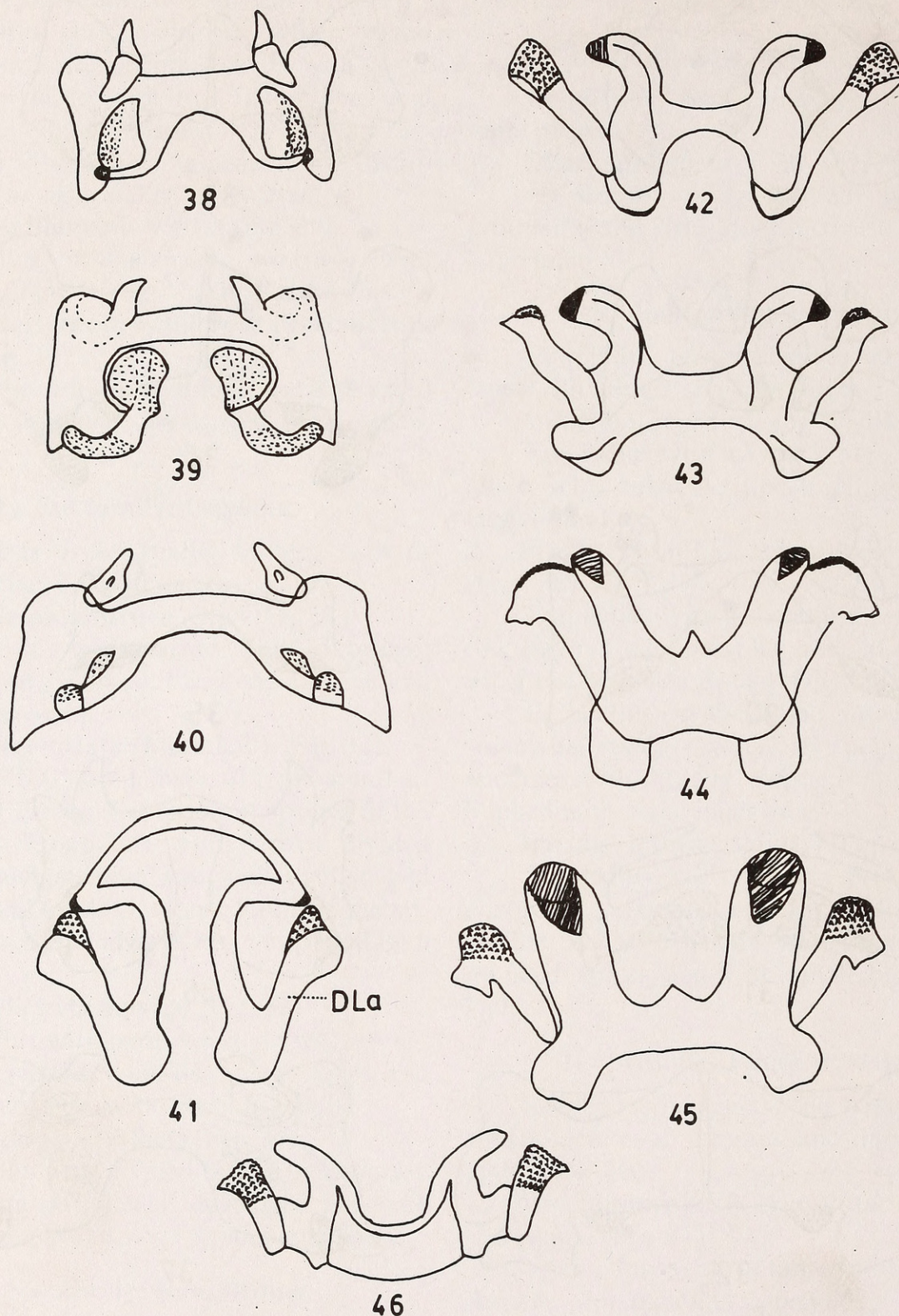
2. **Chrotogonus oxypterus** (Blanchard) (Fig. 42)

Epiphallus with strongly curved lophi, the



Figs. 28-37. Epiphallus in dorsal view

28. *Hieroglyphus banian*, 29. *Leptacris filiformis*, 30. *Spathosternum prasiniferum prasiniferum*, 31. *Gesonula punctifrons*,
 32. *Oxya fuscovittata*, 33. *Oxya hyla hyla*, 34. *Oxya nitidula*, 35. *Teratodes monticollis*, 36. *Tristria pulvinata*,
 37. *Aulacobothrus luticeps*.



Figs. 38-46. Epiphallus in dorsal view

38. *Brachycrotophus longiceps*, 39. *Leva cruciata*, 40. *Truxalis indica*, 41. *Atractomorpha crenulata crenulata*,
 42. *Chrotogonus oxypterus*, 43. *Chrotogonus trachypterus*, 44. *Neorthacris acuticeps acuticeps*, 45. *Poekilocerus pictus*,
 46. *Pyrgomorpha bispinosa bispinosa*.

disc of appendices with small nodules.

3. **C. trachypterus** (Blanchard) (Fig. 43)

Epiphallus with strongly curved lophi.

4. **Neorthacris acuticeps acuticeps** (Bolivar) (Fig. 44)

Epiphallus with small hook-like lophi.

5. **Poekilocerus pictus** (Fabricius) (Fig. 45)

Epiphallus with large hook-like lophi and anterior projections.

6. **Pyrgomorpha hispinosa hispinosa** (Walker) (Fig. 46)

Epiphallus with excurved anterior margin and lophi with curved hooks.

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