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TAXONOMIC SIGNIFICANCE OF THE EXTERNAL MALE GENITALIA IN FAMILY CURCULIONIDAE WITH COMMENTS ON THE STRUCTURE OF THESE ORGANS IN OTHER FAMILIES OF CURCULIONOIDEA (COLEOPTERA : INSECTA)

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Taxonomic importance of male genitalia studied in 797 species of Curculionoidea belonging to families Attelabidae (100), Brenthidae (2), Apionidae (60), Rhynchophoridae (10) and Curculionidae (625), has been highlighted at the level of families as well as in the subfamilies, tribes and genera of Curculionidae. The variations noted in the male genitalia pertain to the relative length of aedeagus, aedeagal apodemes and phallobasic apodeme alongwith the shape of aedeagus and structure of endophallic armature. Several subfamilies, tribes and genera of Curculionidae show a constant structure of male genitalia whereas some others express sufficient diversity, warranting a review of their taxonomic status.

INTRODUCTION

The external genitalia have an important role in the classification of insects and are particularly useful in the order Coleoptera. The male genital structures of Coleoptera have been studied by a number of workers. Starting with the extensive work of Sharp & Muir (1912), subsequent notable contributions on this subject are due to Snodgrass (1935), Zia (1939), Michener (1944), Wood (1952), Brudin (1953), Lindroth (1957), Matsuda (1958 & 1976), Hieke (1966), Kissinger (1968) and Werner (1976). The phallic origin of the male genitalia in Coleoptera has been confirmed by a number of workers (Pruthi, 1924; Metcalf, 1932; Murray & Tiegs, 1937; Pajni, 1967).

The male genitalia of Curculionoidea have been the subject of several authors. In addition to general remarks given by Sharp & Muir (1912), Jeannel (1941 & 1955), Jeannel & Paulian (1944) and Lindroth (1957), the specific studies on this superfamily have been conducted by Bruhn (1947), Gilbert (1952), Morimoto (1962a), Pajni & Bhateja (1973), Clark (1977) and Hamilton (1979). However, a comparative account of the structure of these organs in the superfamily Curculionoidea has not been undertaken so far.

The present studies are based on the male genitalia of 797 species of Curculionoidea belonging to families Attelabidae (100), Brenthidae (2), Apionidae (60), Rhynchophoridae (10) and Curculionidae (625). Previous workers have utilized the structure of aedeagus and the parameres for characterizing different families of Curculionoidea. However, no attempt has so far been made to examine the importance of these and other parts in the subfamilies, tribes and genera of different families and specially the family Curculionidae which is the largest among the families of Curculionoidea. Accordingly, besides supplementing the work of previous workers on the higher classification of superfamily Curculionoidea, an attempt will be made to highlight the significance of the genital differences in the lower taxa under different families of superfamily Curculionoidea.

OBSERVATIONS

The male genitalia of Coleoptera include the chief copulatory organ also called as penis or phallus and the supporting parts of the 8th and 9th abdominal segments. According to Sharp & Muir (1912), the male copulatory organ in Coleoptera is basically *trilobe type* in which the median lobe (aedeagus) lies between the two lateral lobes (parameres). They describe a number of variations in the position, size and degree of fusion in the lateral lobes but refuse to recognise the phallobasic processes of Curculionoidea equivalent to the lateral lobes. Jeannel (1941 & 1955) and, Jeannel & Paulian (1944) made a comparative study of male genitalia in different families of Coleoptera, proposing four types of aedeagus *viz.* trilobe type, invaginated type, annulate type and specialized type. Iablokoff (1976) identifies two types of copulatory organs, one possessing tegmen and the other with the tendency to lose it secondarily.

The male genitalia of Curculionoidea belongs to *annulate type* of Jeannel & Paulian (1944) and consists of a basal usually ring- shaped phallobase and a distal aedeagus of various shapes. The phallobase is always extended on its ventral side into an anterior apodeme which gives attachment to the protractor and retractor muscles of the aedeagus. In many cases, dorsal side of the phallobase is furnished with a pair of short processes, the parameral processes, which are occasionally fused into a single lobe, the *cap piece* of Bruhn (1947). The terminal part of the aedeagus is weakly sclerotized, flexible and invaginated into the basal hard and sclerotized portion. The two parts are named as endophallus and exophallus respectively. The inner surface of the endophallus, which becomes outer surface on eversion at the time of copulation, is beset with a variety of sclerotized structures such as spines, teeth, tubercles, plates and rods, constituting the endophallic armature. The base of the aedeagus is also prolonged into a pair of lateral apodemes which project anteriorly and in many cases support the apical part of the invaginated endophallus. Closely associated with the male genitalia is another sclerotized Y-shaped or rodshaped structure which represents total or partial transformation of the 9th abdominal sternite and is known as *gastral spiculum*. The latter not only supports the aedeagus from below but also helps in the protraction of the same on account of its muscle connection with the phallobase (Clark, 1977). The inward and outward movements of gastral spiculum are controlled with the help of muscles inserted on the 8th tergite and 8th sternite, respectively (Clark, 1977).

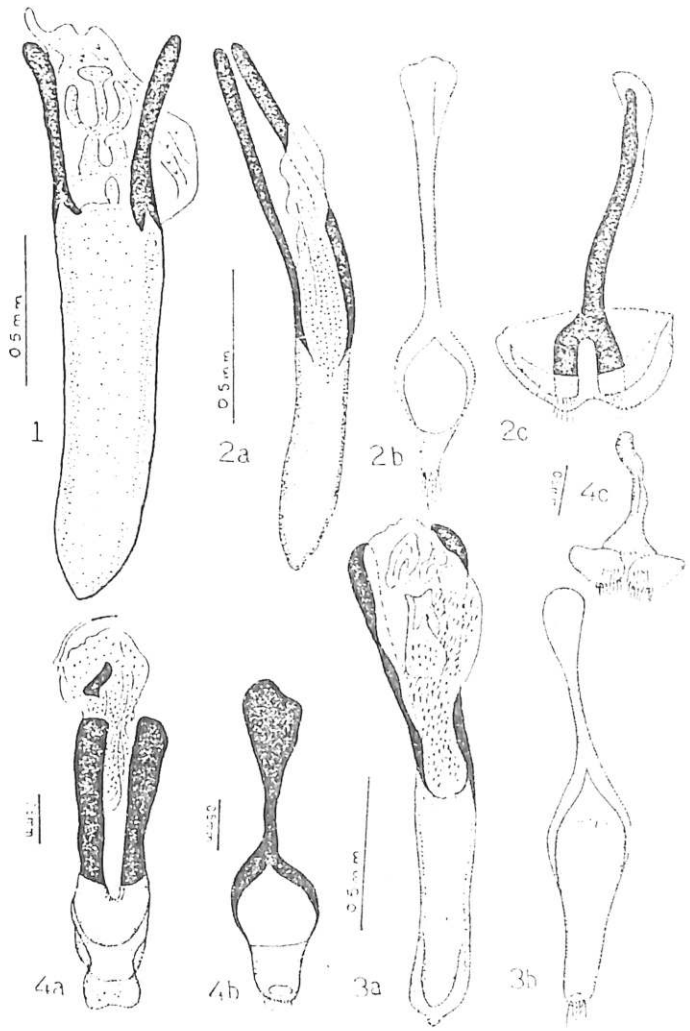
Before taking up the structural variations in the male genitalia of different families of Curculionoidea, it will be worthwhile to mention the limits of these families, as adopted in this work. In spite of the ongoing controversy on the status of Cyladinae, the family Apionidae has been considered to include subfamilies Apioninae, Eurhynchinae (= Cyladinae), Ithycerinae and Nanophyinae. The subfamily Ithycerinae is not available in India. Likewise, despite difference of opinion among different workers (Crowson, 1955; Morimoto, 1962b; Ter-Minassian, 1972) on the relative position of a group of subfamilies, the family Attelabidae, with non-geniculate antennae and scaleless shining bodies, has been accepted to include subfamilies Attelabinae, Apoderinae, Rhynchitinae and Pterocolinae, the last mentioned not represented in Indian fauna. Following Morimoto (1962b), family Rhynchophoridae has been considered to include subfamilies Rhynchophorinae, Cryptoderminae and Sipalinae. As far as the classification of the family Curculionidae is concerned, its two major divisions *viz. Curculionidae Adelognathes* and *Curculionidae Phanerognathes*, established by Lacordaire (1863), have been accepted. Whereas the former group includes five subfamilies *viz.* Eremninae, Otiorrhynchinae, Brachyderinae, Tanyrrhynchinae and Sitoninae, the latter group comprises all the remaining subfamilies excluding those which have been referred to other recently established families.

Structure of Male Genitalia in different families of Curculionoidea

The families of Curculionoidea studied by the author include Curculionidae, Attelabidae, Apionidae, Brenthidae and Rhynchophoridae. The differences in the structure of male genitalia separating different families pertain largely to the structure of aedeagus and the shape and size of parameral processes. The status of 8th tergite is also different in some of the families.

Family Attelabidae

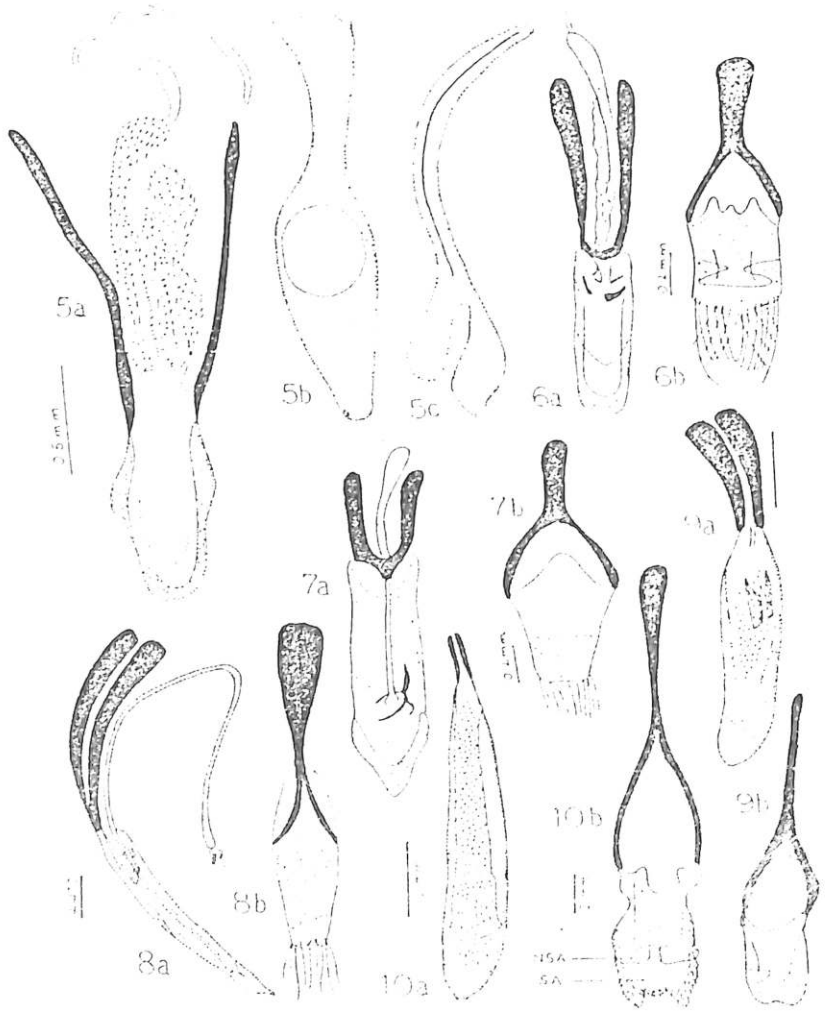
The male pygidium is formed by the 7th tergite of the abdomen. The aedeagus is more or less clearly differentially sclerotized to form prominent dorsal and ventral plates of Morimoto (1962a). The parameral process is unpaired and rather large in size, usually bearing a group of setae at its apex.



Figs. 1-4. Male genitalia of Curculionoidea. 1. *Auletobius (Aletinus)* sp.; 2. *Deporaus (Bilarodepus) solitarius* Voss; 3. *Eugnamptus (Eugnamptobius) affinis* Voss; 4. *Paroplapoderus (Paroplapoderus) breviceps* Voss.
(a = Aedeagus; b = Phallobase; c = Gastral spiculum)

Rhynchitinae (Figs. 1, 2, 3) : The shape of the aedeagus and the parameral process is almost uniform throughout the group. The aedeagus is moderately long, narrow and of uniform width, with its apex usually rounded or occasionally with a short median prolongation. The parameral process is long and conical with prominent setae at its free end. The aedeagal apodemes and the phallobasic apodeme are well developed and mostly have a length almost equal to that of aedeagus. The gastral spiculum is quite long, thick and usually Y-shaped.

Apoderinae (Fig. 4) : The male genital organs are characterized by a short and conical aedeagus, thick aedeagal apodemes which are always longer than aedeagus, a massive phallobasic apodeme usually dilated or swollen at free end, a short and sub- trapezoidal parameral process and by a rather weakly sclerotized and short gastral spiculum. The shape of the aedeagus and the general composition of the endophallic armature also



Figs. 5-10. 5. *Attelabus* sp.; 6. *Shiva assamensis* Pajni and Bhateja; 7. *Nanophyes plumbeus* Motschulsky; 8. *Manoja orientalis* Pajni and Bhateja; 9. *Onychapion tamaricis* (Gyll.); 10. *Onychapion spinotarsotus* Pajni and Bhateja.

characterize several genera such as *Paroplapoderus* Voss, *Tomapoderus* Voss, *Physapoderus* Jekel and *Centrocorynus* Jekel.

Attelabinae (Fig. 5) : In this sub-family, the aedeagus is short with broadly rounded apex and long apodemes. The phallobase bears a conical parameral process and a very strong apically broadened apodeme. The gastral spiculum is Y-shaped with its free arms strongly curved. The extent of variation in this sub-family could not be studied due to paucity of material.

Family Apionidae

The male pygidium is formed by the 8th tergite of the abdomen. The aedeagus is highly variable in shape as well as in the texture of its apical margin. The aedeagal apodemes are shorter than aedeagus but the variation in their length is quite wide, becoming very much reduced in extreme cases. The parameral process in most cases is fused in the larger proximal region and is disposed into two short setose lobes in the apical region. In some cases, the apex of the parameral process is produced into a single median process. The phallobasic apodeme is thick, short and generally dilated towards the free end. The endophallic armature may be very slight in some cases or highly complex in others.

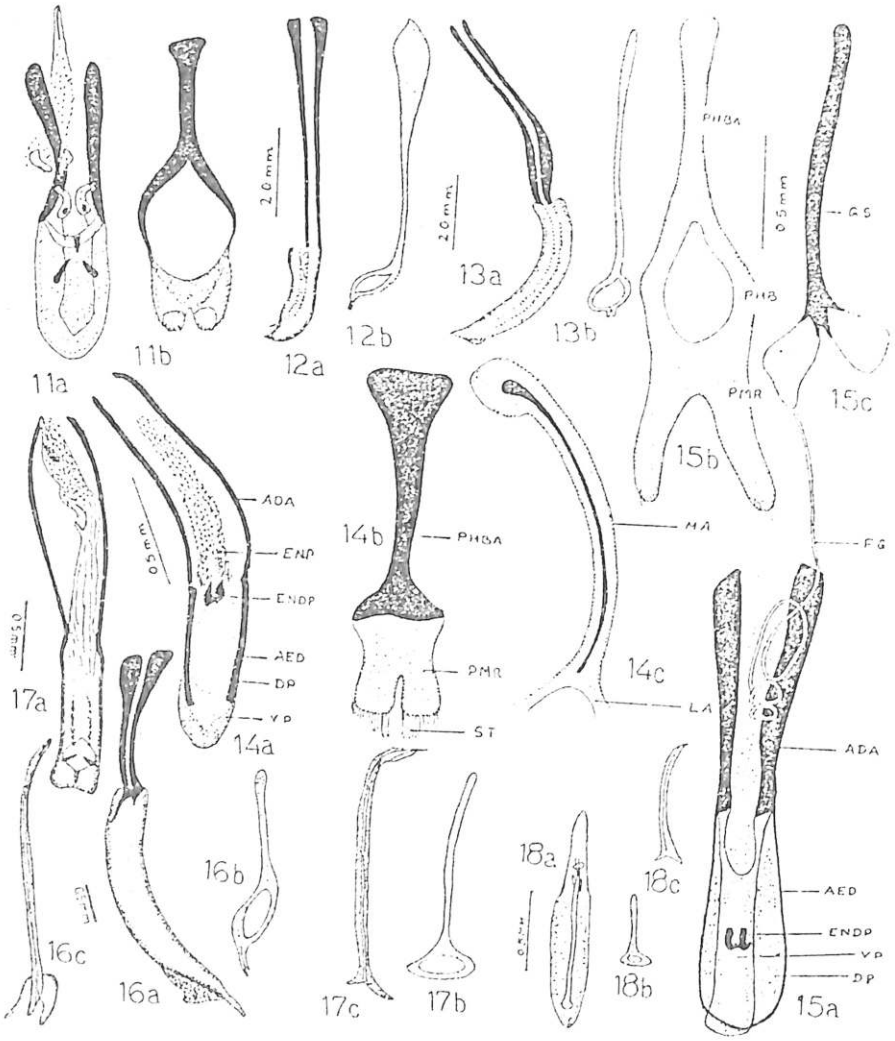
Nanophyinae (Figs. 6, 7, 8) : The aedaegus is short or moderately long, dorso-ventrally compressed and rounded or broadly truncate at apex. The aedeagal apodemes as well as the phallobasic apodemes are relatively thicker than those of Apioninae. The endophallic armature is poorly developed but there is always present a short or long flagellum. The apical lobes of the parameral process may be prominent or indistinct. The genus *Manoja* Pajni and Bhateja is characterized by a narrow aedeagus and a very long flagellum.

Apioninae (Figs. 9, 10) : The aedeagus is narrow, curved and conically terminated. Its dorsal plate is shorter than the ventral plate and the phallotreme is, therefore, located sub-apically on the dorsal surface. The aedeagal apodemes are comparatively narrower than those of subfamily Nanophyinae. The endophallus is usually with poorly developed armature. The parameral process is apically bilobed or unilobed like Nanophyinae and its surface is marked by clear non-sclerotized areas as well as by median and lateral cristae (Kissinger, 1968). The structure of the genitalia is more or less uniform throughout the subfamily with hardly any marked features characterizing a particular genus.

Cyladinae (Fig. 11) : The aedeagus is dorsoventrally flattened like that of Nanophyinae and is not constituted by well differentiated dorsal and ventral plates. Moreover, the endophallic armature is very complex and consists of large sclerotized plates. The parameral process, aedeagus and phallobasic apodeme also show resemblance with those of Nanophyinae.

Family Rhyncophoridae (Figs. 12, 13)

The pygidium is constituted by the 7th tergite of the abdomen. The aedeagus consists of the complete ventral plate and the complete or reduced dorsal plate. It is usually narrow and curved and its apodemes are in most cases longer than its length. The phallobase forms a complete ring without or with reduced parameral processes. The phallobasic apodeme is weakly sclerotized but shows a tendency to become thickened and broadened at the free end. The endophallic armature is usually poorly developed. There are hardly any notable features characterizing any of the 10 studied genera. The overall structure of the male genitalia also does not present any special features distinct from those of Curculionidae. In fact, the structure of male genitalia does not provide any



Figs. 11-18. 11. *Protocylas impunctatus* (Fst.); 12. *Rhynchophorous ferrugineus* Ol.; 13. *Diocalandra frumenti* Fst.; 14. *Desmidophorus* sp.; 15. *Eupsalis* sp.; 16. *Episomus figulus* Boh.; 17. *Myllocerus dentifer* F.; 18. *Notognathus varius* Mshl.

(AED = Aedeagus; ADA = Aedeagal apodeme; DP = Dorsal plate; ENP = Endophallus; ENDP = Endophallic plate; FG = Flagellum; GS = Gastral spiculum; LA = Lateral arm; MA = Median arm; NSA = Non sclerotized area; OP = Orificial plate; PHB = Phallobase; PHBA = Phallobasic apodeme; PHT = Phallotreme; PMR = Paramere; SA = Sclerotized area; ST = Setae; VP = Ventral Plate)

support for separating this group from Curculionidae and its upgradation to the level of a family.

Family Brenthidae (Figs. 14, 15)

The pygidium is formed by the 8th tergite of the abdomen. The aedeagus has distinct dorsal and ventral plates, although the latter is much better developed than the former. The aedeagal apodemes are longer than the aedeagus. The endophallus carries a pair of curved chitinized plates and a long flagellum. The phallobase carries a strong apodeme ventrally and a pair of apically setose and basally fused parameral processes. The gastral spiculum is well developed.

The parameres are free at their tips in the subfamily Desmidophorinae but they are free in the 2/3rd distal region in the case of Brenthinae.

Family Curculionidae

The pygidium of the male is always constituted by the 8th abdominal tergite. The shape and size of the aedeagus, aedeagal apodemes and the gastral spiculum are highly variable. Likewise, the condition of the presence or absence of the parameral processes also shows differences not only in the subfamilies but also in the genera and species. However, the parameral processes, when present, are relatively shorter than those of Apionidae and Attelabidae and are devoid of any setae. The shape and size of the phallobasic apodeme also varies a good deal. The endophallic armature is most poorly developed but highly developed in some cases.

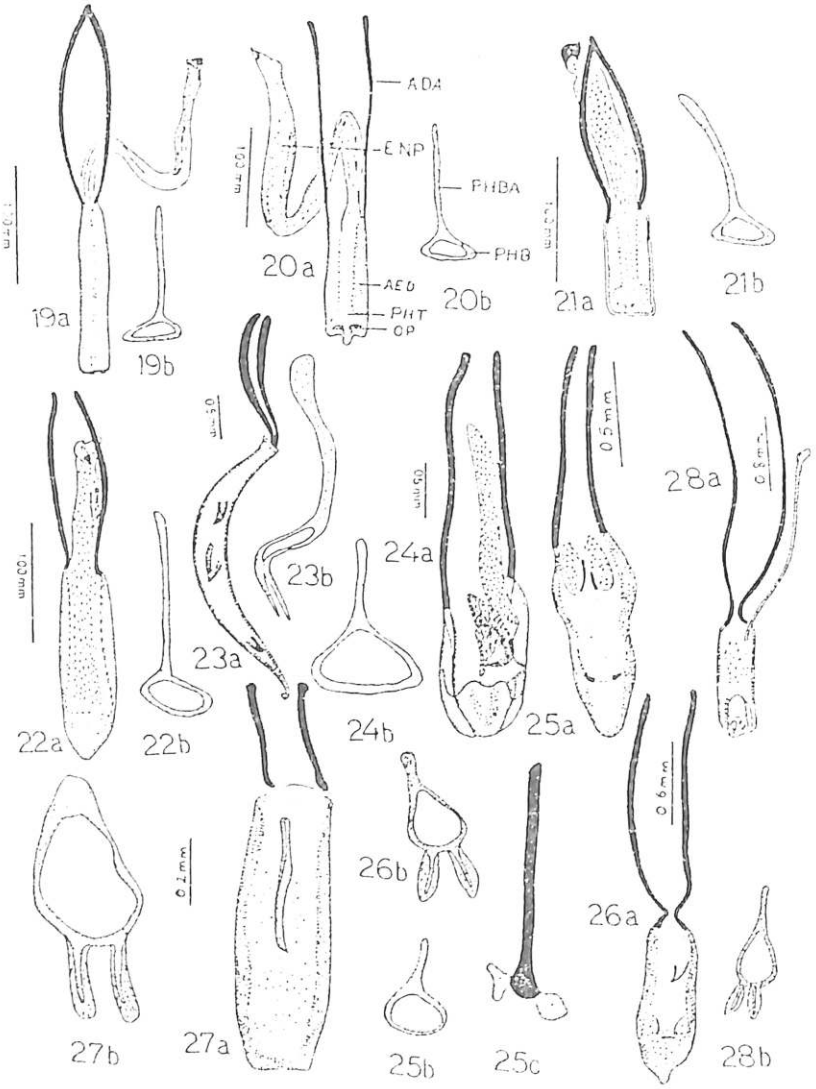
The Curculionidae Adelognathes, comprised by four Indian subfamilies *viz.* Eremninae, Otiorrhynchinae, Brachyderinae and Sitoninae also show notable differences among the component parts of the male genitalia and there are hardly any common features characterizing the group unlike their internal genitalia (Pajni & Shoba, 1988; Shoba & Pajni, 1988) and, number and structure of the chromosomes (Sharma & Pal, 1982; Gill, 1982; Sharma *et al.*, 1984).

Under Curculionidae Phanerognathes, none of the subfamilies has completely uniform male genitalia although a few subfamilies can be characterized on the basis of one or the other feature. For example, the subfamily Cleoninae is characterized by the extreme reduction of the aedeagal and phallobasic apodemes, with the former reduced to mere vestiges. Likewise, the subfamily Baridinae always has leaf-like parameral processes. The variations at the level of tribes and genera show certain co- relations as described below.

Otiorrhynchinae (Figs. 16, 17, 18) : The parameral processes are present in the tribes Episomini and Laparocerini but are missing in the tribes Ptochini, Phyllobini and Nothognathini. The aedeagus is dorsoventrally compressed in the tribe Ptochini and shows close resemblance with that of Eremninae. This provides support to the shifting of the subfamily Eremninae under the tribe Ptochini by Morimoto (1962b). The aedeagus in the tribe Episomini, on the other hand, is narrow and curved approaching the structure of aedeagus in the tribe Tanymecini of Brachyderinae. At the generic level, a constantly uniform structure of male genitalia is witnessed in the genera *Myllocerus* Schonherr, *Ptochus* Schonherr and *Episomus* Schonherr.

Eremninae (Figs. 19, 20, 21, 22) : The structure of male genitalia shows high degree of uniformity in which the aedeagus is straight and parallel-sided, with its apex truncate, slightly sinuate or minutely produced in middle. The apex of aedeagus is always truncate in the tribe Acanthotrachelini. In the tribe Cyphicerini, the shape of the aedeagus is closely similar to that of Ptochini of Otiorrhynchinae. However, the aedeagus in the genera *Indophytoscaphus* Pajni and Sidhu, *Parascapus* Marshall and *Rhicnostomus* Marshall is narrow and more or less conical.

Brachyderinae (Figs. 23, 24) : Based on the structure of male genitalia, the subfamily Brachyderinae can be divided into two sections. In the first section comprised by 4 tribes *viz.* Tanymecini, Cratopini, Polydrosini and Cneorrhinini, the aedeagus is narrow, elongate, curved and conically pointed, with rather short apodemes. The phallobase bears a pair of parameral processes. The genitalia of this section closely tally with those of the tribe Episomini of Otiorrhynchinae. The second section including the tribes Blosyrini and Dermatodini, has a thick and straight aedeagus with rounded or conical apex and long apodemes. The endophallic armature is usually complex. In the tribe Blosyrini, the endophallic armature consists of rod-shaped plates. As the structure of



Figs. 19-28. 19. *Aspidomycter lunatus* Mshl.; 20. *Amblyrrhinus poricollis* Schonherr; 21. *Rhicnostomus terrenus* Mshl.; 22. *Lagenolobus pubescens* Hust.; 23. *Scepticus noxius* Fst.; 24. *Blosyrus oniscus* Ol.; 25. *Sitona* sp.; 26. *Baris notolineatus* Pajni & Kohli; 27. *Athesapeuta quinomaculata* (Fst.); 28. *Acythopeus aterrimus* (Wat.).

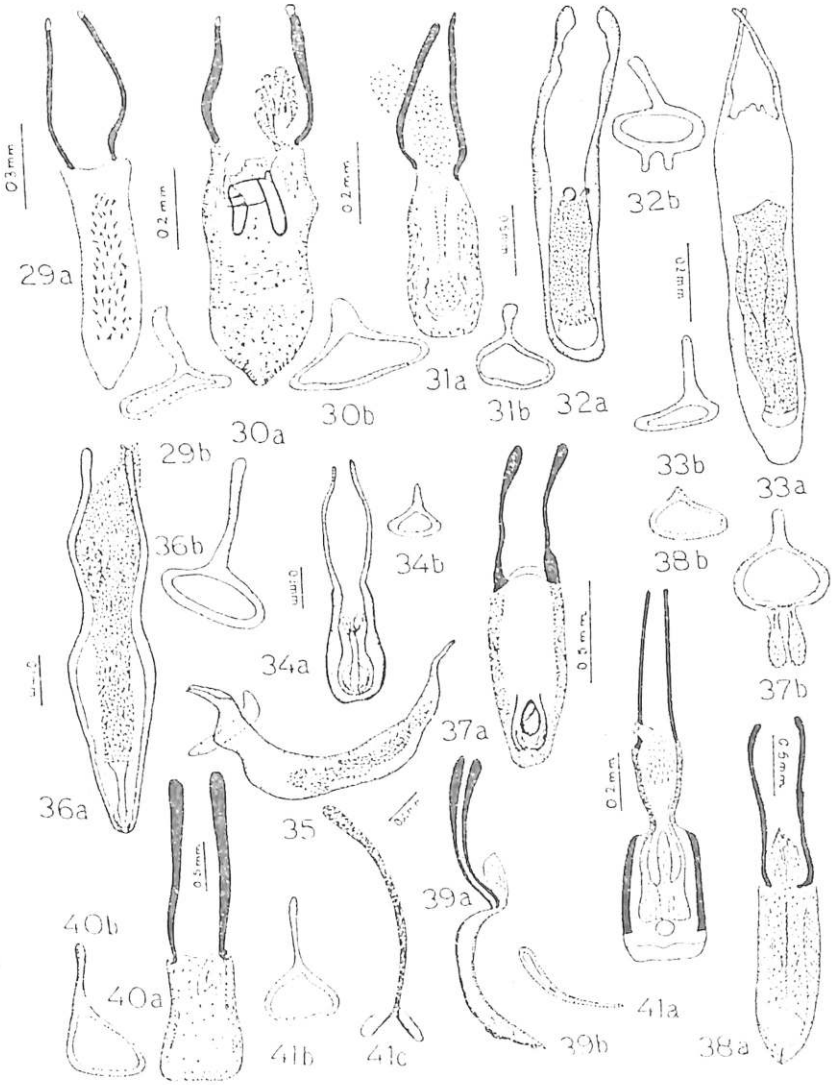
the male genitalia more or less conforms to a basic pattern characteristic of each tribe, discrimination at the generic level is not pronounced.

Sitoninae (Fig. 25) : The aedeagus is dorso-ventrally flattened but conically terminated at its apex, with the dorsal plate not differentiated and the phallotreme shifted away from the apex. The aedeagal apodemes are longer than the aedeagus. The phallobase is with a short apodeme and without parameral processes. The structure of male genitalia appears quite separate from those of the other three short-snouted subfamilies.

Baridinae (Figs. 26, 27, 28) : This subfamily is characterized by the presence of paired leaf-like parameres, reduced phallobasic apodeme and dorso-ventrally compressed aedeagus with a broad apex. The aedeagal apodemes are quite reduced in *Athesapeuta* Faust and unusually long in *Acythopeus* Pascoe.

Ceuthorrhynchinae (Figs. 29, 30, 31) : This subfamily is characterized by the absence of parameres, dorso-ventrally compressed and variously shaped aedeagus and reduced phallobasic apodeme. The tribe Hypurini shows complex endophallic armature not seen in Mecysmoderini, Ergiini and Phytobini. The endophallic armature in *Hypurodes* Colonn. consists of long spines.

Hylobiinae (Figs. 32, 33, 34) : The aedeagus in this subfamily is usually oblong and rounded or broadly conical at apex. The phallobase usually carries pointed parameral processes

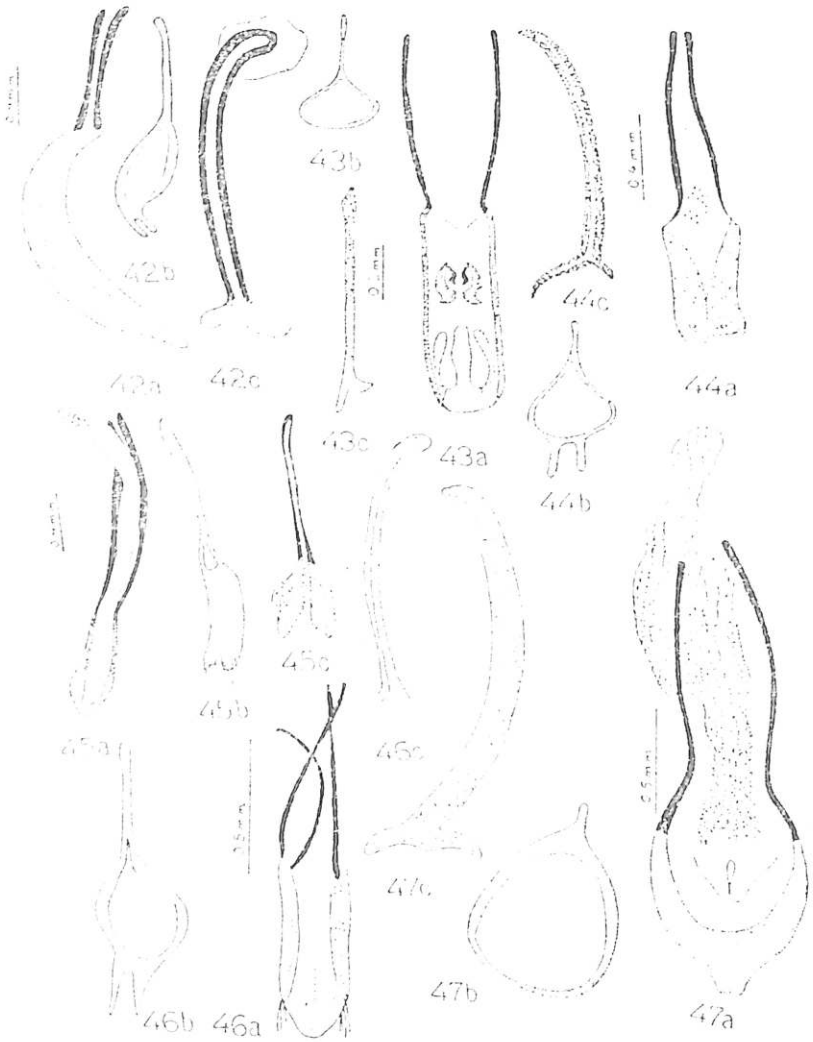


Figs. 29-41. 29. *Rhinoncus (Amalorhinoncus) pagnus* (Gyll.); 30. *Hypurodes portulacae* Mshl.; 31. *Mecysmoderus mencylonis* Mshl.; 32. *Dirodes chandigarhensis* Pajni & Sood; 33. *Threcticus albositosus* Pajni & Sood; 34. *Peribleptus scalptus* Boh.; 35. *Atactogaster zebra* (Chevr.); 36. *Tachyerges fuscus* Pajni & Sood.; 37. *Brahmalcidodes micronychus* (Pascoe); 38. *Mecyslobus (Mecyslobus) fascianus* (Redt.); 39. *Tuberculomecyslobus profanus* (Haaf.); 40. *Alcidodes molitor* Hell.; 41. *Rhadinomerus rugosissimus* Pajni & Arya.

and short apodeme. The genus *Peribleptus* Schonherr, however, lacks the parameral processes.

Cleoninae (Fig. 35) : The male genitalia of the subfamily Cleoninae is characterized by the laterally compressed, curved and conically terminating aedeagus, extremely reduced aedeagal and phallobasic apodemes and by the absence of parameres. The structure is fairly uniform among different genera.

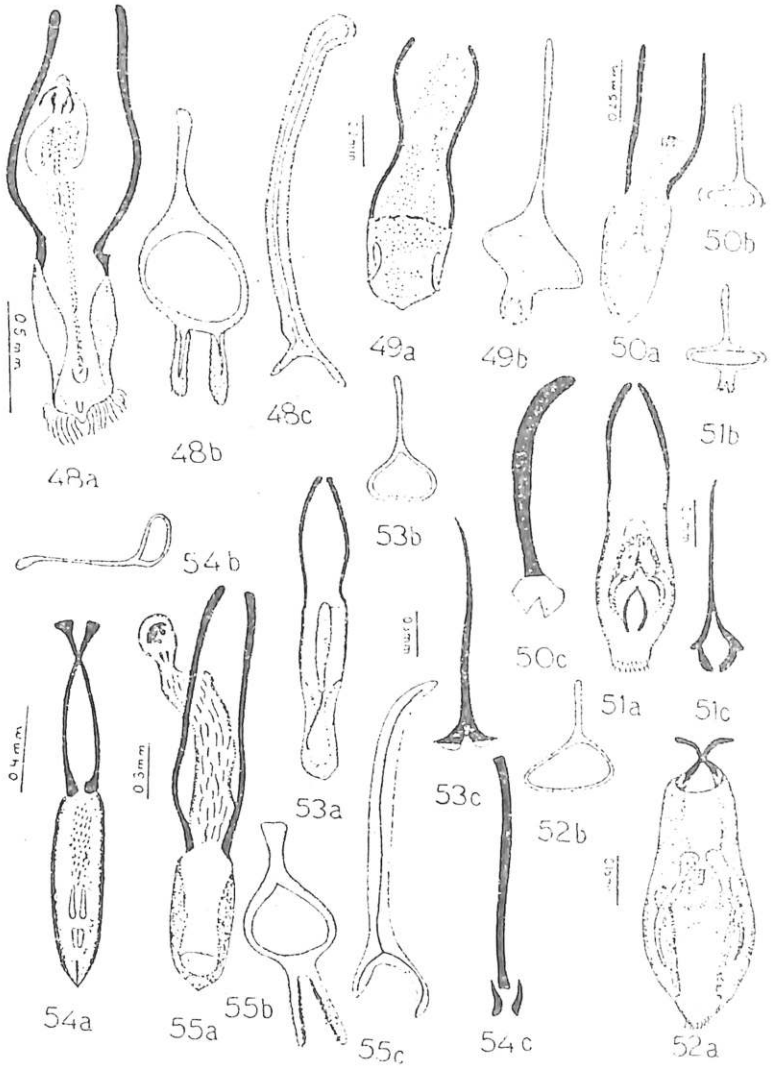
Rhynchaeninae (Fig. 36) : The more or less uniform features of the genitalia include oblong aedeagus, absence of parameral processes and the phallobasic apodeme much shorter than the aedeagal apodemes.



Figs. 42-47. 42. *Pachyonyx quadridens* Chevr.; 43. *Camptorhinus affinis* Fst.; 44. *Dystropicus clitella* Fst.; 45. *Tadius erirhinoides* Pascoe; 46. *Lobotrachelus subfasciatus* Mots.; 47. *Metialma scenica* Pascoe.

Alcidodinae (Figs. 37, 38, 39, 40) : The phallobasic apodeme is greatly reduced throughout the subfamily. The structure of aedeagus is, however, very different even among the species of the same genus. Genus *Brahmalcidodes* Pajni and Dhir, is characteristic in having a complete dorsal plate in the aedeagus and reduced aedeagal apodemes. The aedeagus is usually curved and narrowed to a pointed apex in *Neomecyslobus* Pajni and Dhir and *Tuberculomecyslobus* Pajni and Dhir. In the sub-genus *Mescyslobus* s. str., the apex of aedeagus is abruptly produced into a narrow process. The aedeagus of genus *Alcidodes* Marshall is dorso- ventrally compressed and has a rounded apex. Moreover, the parameral processes are well developed in this genus.

Cryptorrhynchinae (Figs. 41, 42, 43, 44, 45) : The structure of male genitalia is variable in the tribes Camptorhinini, Ithyporini and Cryptorhynchini. In the tribe Mecistocerini, however, the genitalia can be characterized by the dorso- ventrally compressed aedeagus with truncate or broadly rounded apex and by the parameral processes. At the generic



Figs. 48-55. 48. *Mecopus bispinosus* Weber; 49. *Echinocnemus longirostris* Pajni & Tewari; 50. *Hypera mediacaginis* Mshl.; 51. *Bagous interruptus* Fst.; 52. *Bagous* sp.; 53. *Cionus dependens* Fst.; 54. *Curculio bimaculatus* Fst.; 55. *Pimelata maculata* Pascoe.

level, two genera of Camptorhini have distinctive male genitalia. The aedeagus in *Pachyonyx* Schonherr is laterally compressed and conically produced and, the parameres are present. In the *Camptorhinus* Schonherr, the aedeagus is dorso-ventrally compressed with broad apex and the parameres are absent. Under the tribe Ithyporini, the genera *Dystropicus* Pascoe and *Colobodes* Schonherr have dorso-ventrally compressed aedeagus with broad apex, with the parameres present in the former and absent in the latter. The other three genera *viz. Tadius* Pascoe, *Mecocorynus* Schonherr and *Ectatorhinus* Lacordaire have narrow and cylindrical aedeagus. Out of these, *Tadius* Pascoe has well developed parameres which are almost fused together while the other 2 genera do not show any parameral processes.

Zygopinae (Figs. 46, 47, 48) : The aedeagus is usually short, dorso-ventrally flattened and truncate or broadly conical at apex. The aedeagal apodemes are usually longer than or as long as aedeagus. At the tribal level, Lobotrachelini is characterized by a short aedeagus and by the rod-shaped flagellum. In the tribe Coryssomerini, the phallobase has a reduced apodeme and is without parameres. Isorhynchini also lacks the parameres which are, however, present in Othippini. The genus *Mecopus* Schonherr has two pairs of curved endophallic plates and the conical aedeagus bears a group of setae at its tip.

Hyperinae (Figs. 49, 50) : The aedeagus is dorso-ventrally compressed with a broad apex and with equal or longer aedeagal apodemes. Genus *Echinocnemus* Schonherr, has moderately developed basally fused parameres which are absent in *Donus* Jekel and *Hypera* Germar.

Bagoinae (Figs. 51, 52) : The aedeagus is dorso-ventrally compressed but with variable shapes even within the genus *Bagous* Germar. The parameres are present in some species and are absent in others.

Cioninae (Fig. 53) : The aedeagus is cylindrical, more or less laterally compressed in middle and is always longer than its apodemes. The parameres are not developed.

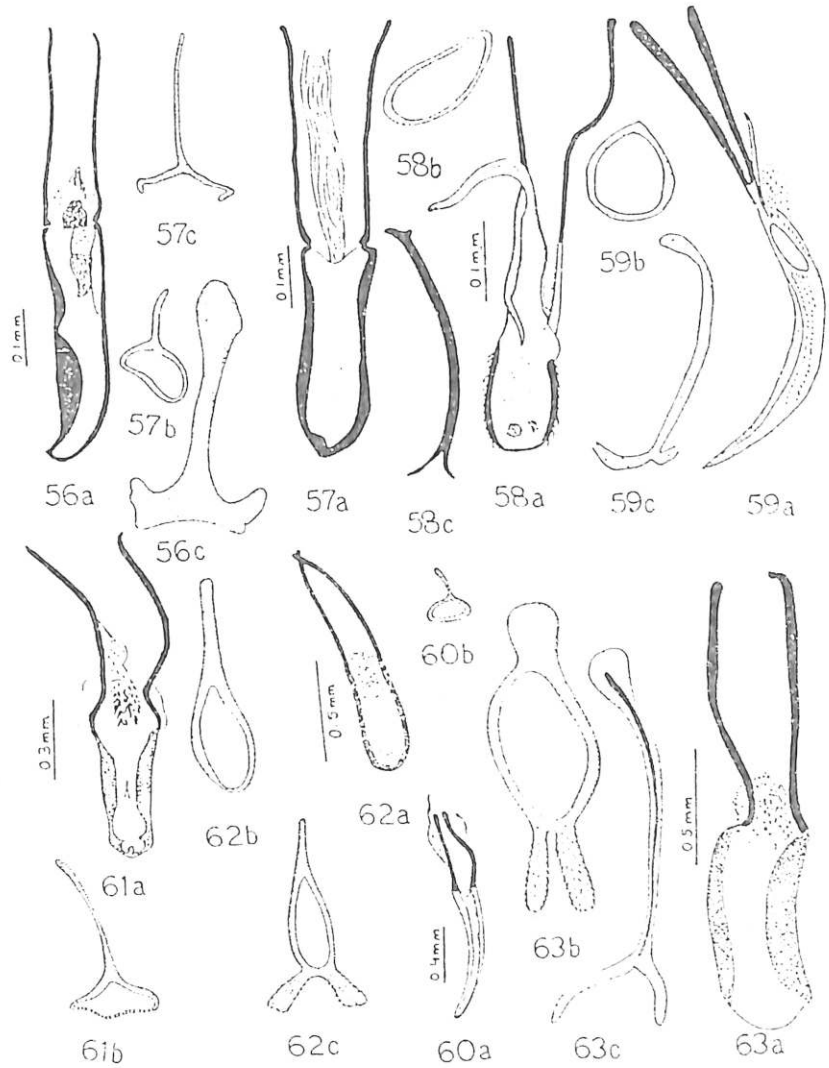
Curculioninae (Figs. 54, 55) : The only uniform feature of the male genitalia of Curculioninae is the presence of a rod-shaped gastral spiculum. The latter is always associated with a pair of *spicule plates* (Bruhn, 1947) at its base in the genus *Curculio* L. The genus *Pimelata* Pascoe is characterized by a pair of long parameral processes which are otherwise absent in this subfamily.

Tychiinae (Figs. 56, 57) : The shape of aedeagus is quite variable but the parameral processes are absent in all the five studied genera *viz. Sphinxiodes* Voss and Chujo, *Endaeus* Schonherr, *Gryphorhynchus* Roelofs, *Endeanidius* Morimoto and *Sibinia* Germar.

Cossoninae (Fig. 58) : The phallobase has a reduced apodeme and is devoid of parameral processes. The aedeagus is dorso-ventrally compressed and has variable shapes.

Anthonominae (Fig. 59) : The aedeagus is flat and ribbon like, slightly curved in middle and rounded at apex. The aedeagal apodemes are well developed and long. The endophallic armature is poorly developed. The phallobase is without any parameral processes and carries an extremely reduced apodeme. The gastral spiculum has a very long median arm and short lateral arms.

Gymnetrinae (Fig. 60) : The aedeagus is curved, narrow and pointed at apex and sclerotized on lateral sides. The aedeagal apodemes are about half as long as the aedeagus. The phallobase is without parameres and with a short apodeme.



Figs. 56-63. 56. *Gryphorhynchus* sp.; 57. *Sibinia* sp.; 58. *Xenomimetes sikkimensis* Mshl.; 59. *Acallopistus* sp.; 60. *Gymnetronm amictum* Germ.; 61. *Hedychrous rufofasciatus* Mshl.; 62. *Tanysphyrus* sp.; 63. *Pissodes notatus* F.

Smicronychinae (Fig. 61) : The aedeagus is broad and rounded at apex, with the aedeagal apodemes a little longer than its length. The endophallus is moderately developed. The phallobase is without parameral processes and bears a long apodeme which is slightly shorter than the aedeagus.

Tanysphyrinae (Fig. 62) : The aedeagus is dorso-ventrally flattened, broadly conical at apex, with poorly sclerotized dorsal and ventral walls and with well developed apodemes. The endophallus is poorly developed. The phallobase forms an elongate ring and is without any parameral processes. The gastral spiculum has lateral arms longer than the median arm.

Pissodinae (Fig. 63) : The aedeagus is broad, parallel sided, dorso-ventrally flattened and almost truncate at apex. The aedeagal apodemes are long and stout. The endophallus is moderately developed. The phallobase has a pair of leaf-like parameral processes and

a short but much broadened apodeme. The gastral spiculum is long, with the lateral arms much shorter than the median arm.

REMARKS

The study of male genitalia in the superfamily Curculionoidea shows that the structure of this organ is highly specific and no two species have a similar type of male genitalia. The main discriminatory features are located in the endophallic armature. Many genera *viz. Paroplapoderus* Voss, *Manoja* Pajni and Bhateja, *Ptochus* Schonherr, *Acythopeus* Pascoe, *Mecopus* Schonherr and *Pachyonyx* Schonherr also show a more or less constant structure of the male genital organs in the component species. A few large genera such as *Apoderus* Olivier, *Myllocerus* Schonherr, *Episomus* Schonherr, *Alcidodes* Marshall, *Tadius* Pascoe and *Lobotrachelus* Schonherr present two or more different patterns on the basis of which their further sub-division could be considered. The structure of genitalia in the tribes and subfamilies does not conform to any particular type of collective pattern. However, several of these taxa can be characterized on the basis of one or the other feature as in the case of subfamilies like Cleoninae, Baridinae and Ceuthorrhynchinae and also in the case of tribes Episomini, Laparocerini, Acanthotrachelini, Blosyrini, Dermatodini, Hypurini, Mecistocerni and Isorhynchini. A similar criterion can also be applied to a few families like Attelabidae, Brenthidae and Apionidae. On the whole, the Curculionoidea have some special features in the male genitalia *i.e.* the paired aedeagal apodemes, the single phallobasic apodeme and the absence of pronounced parameres.

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