The family Asillidae has been much neglected by morphologists. Snodgrass (1902) and Reicherdt (1929) are the only accounts available on the anatomy of the male genitalia. Except making a mention of the three pairs of muscles that are responsible for the movement of the intromittent organ, Reicherdt (1929) has confined himself to the description of skeletal system only.

The genitalia of Machimus (Tolmerus) punjabensis in their structural details show great resemblance with the genitalia of Tipuliidae and Anisopodidae.

The male terminalia are composed of segments 8-11, although the seventh segment is also intimately associated with the same. They are strongly laterally compressed and highly sclerotized. Although Snodgrass (1902) has recorded a rotation of the male terminalia in Dasyllis and Laphria, other genera of the family including Machimus do not seem to undergo any such rotation through 180.

The eighth segment is quite normal in appearance but is partly concealed by the well developed preceding segment. The eighth tergum (Fig.Mp.1;T8) is slightly concave on the posterior side and normally overlaps the basal portion of the ninth tergum.

The eighth sternum (Fig.Mp.1;S8) is also concave on the posterior aspect, and partly conceals the following sternum.

The ninth segment evinces many structural peculiarities. Its tergum (Fig.Mp.1,2;T9) is medially cleft for the greater part of its length, resulting in the formation of two well developed lateral, cercus-like structures between which is located the procotiger (Fig.Mp.1,2;Ptgr). Reicherdt (1929) calls these structures as 'oberer Haltesänge', or the upper claspers, which play an impor-
tant role in mating.

The ninth sternum (Fig.Mp.1;Sg) is medially deeply concave. Laterally, on each side it bears the paramere (PMR) which consists of a basimere (bmr) and a telomere (tmr). Reichardt (1929) calls the basimere as 'untere Haltezange' or the lower claspers, and the telomere as paramere. This interpretation, however, cannot be accepted. The entire two-segmented structure, and not its apical part only, represents the true paramere. The telomere is articulated with the basimere, and is movable by means of the muscles arising in the latter. The basimere, likewise, receives muscles from the ninth sternum.

The intromittent organ (Fig.Mp.2;10) is a highly sclerotized structure and is more or less a mirror image of its counterpart met with in Tipulidae and Anisopodidae, and appears to be similarly derived from the ejaculatory duct. The intromittent organ distally gets three pronged, the median prong carrying the opening of the ejaculatory duct at its base (Gpr). Snodgrass (1902) was of the opinion that the seminal passage divides into three tubes at the bases of the prongs and opens by three apertures at their tips.

The intromittent organ for the greater part of its length is enclosed in a membranous sac, the genital chamber (Fig.Mp.2;GC). The latter is reinforced by an elaborate endo-skeleton which is composed of two parts, viz., a vertical, and a horizontal.

The vertical part is more or less U-shaped in cross-section, and postero-dorsally is produced into a large wing-like extension on either side. A similar but relatively much smaller extension is also present in the antero-ventral aspect on each side(b).

Postero-ventrally on each side, the vertical part is continued into a posteriorly directed rod-like structure (r) which presents a slightly twisted appearance. The posterior extremity
of each rod is fused with the ventral margin of the ninth tergum just above the articulation of the latter with the basimere. The two lateral rods are connected with each other by a stretch of membrane which forms the roof of the genital chamber. Meicherdt (1929) does not describe any structure corresponding to the horizontal part of the endoskeleton in his studies on Asilidae.

A vertically flat internal apodeme (Fig. Mp.2; ApIo) is associated with the base of the intromittent organ and is responsible for the movement of the latter through the action of muscles.

The tenth sternum (Fig. Mp.2; S10) is in the form of a well sclerotized, arched, more or less rectangular plate which is postero-ventrally produced in the form of a flap-like structure on either side (c).

The sternum of the eleventh segment (Fig. Mp.2; S11) is in the form of two longitudinal plates lying side by side, making a slightly obtuse angle with the tenth sternum which apparently gives them a postero-dorsal orientation.

The terga of the tenth and eleventh segments apparently seem to have fused with each other to give rise to the two longitudinal plates lying side by side (Fig. Mp.2; T10+11).

The proctiger which is formed by the segments 10-11 (Ptgr) provides exit to the alimentary canal at its tip, through the anus.

Muscles of the terminalia

Besides the muscles which are associated with the parameres, the genital chamber and its endoskeleton, and the intromittent organ, other muscles of the male terminalia can conveniently be placed in three categories, viz., the inter-tergal muscles, the inter-ster nal muscles, and the tergo-ster nal muscles.

I. Inter-tergal muscles:

Retractor of the ninth tergum: (Fig. Mp.3; 1)

This muscle arises dorso-laterally on the basal region of
the eighth tergum, and is likewise inserted on the basal margin of the ninth tergum.

Retractor of the ninth tergum: (Fig. Mp.3; 2)

This muscle arises ventro-laterally on the eighth tergum, and is inserted dorso-laterally on the basal margin of the ninth tergum, outer in relation to muscle No: 1.

II. Inter-sternal muscles:

Retractor of the ninth sternum: (Fig. Mp.3; 3)

This muscle arises dorso-laterally on the basal margin of the eighth sternum, and is likewise inserted on the basal margin of the ninth sternum.

Retractor of the ninth sternum: (Fig. Mp.3; 4)

This muscle arises on the basal margin of the eighth sternum, outer in relation to the muscle No: 3, and is inserted ventro-laterally on the basal margin of the ninth sternum.

Retractor of the eleventh sternum: (Fig. Mp.3; 5)

This muscle arises postero-laterally on the tenth sternum, and is likewise inserted on the lateral plate of the eleventh sternum.

III. Tergo-sternal muscles:

Tergo-sternal retractor of the eighth sternum: (Fig. Mp.3; 6)

This muscle arises laterally on the eighth tergum, and is inserted on the inter-segmental membranous area, in the postero-dorsal vicinity of the eighth sternum.

Ventral retractor of the tenth sternum: (Fig. Mp.3; 7)

This muscle arises postero-ventrally on the cercus-like portion of the ninth tergum, and is inserted antero-laterally on the tenth sternum.

Dorsal retractor of the tenth sternum: (Fig. Mp.3; 8)

This muscle arises on the dorso-lateral aspect of the basal margin of the ninth tergum, and is inserted postero-
laterally on the tenth sternum

IV. Muscles of the paramere:

Adductor of the paramere: (Fig. Mp. 3; 9)

This very strong muscle arises broadly on the outer wall of the cercus-like portion of the ninth tergum, and is inserted on the posterior end of the rod-like structure (r), just above the articulation with the basimere. This muscle also partly acts as an adductor of the cercus-like structure.

Abductor of the paramere: (Fig. Mp. 3; 10)

This muscle arises dorso-laterally on the posterior aspect of the ninth sternum, and is obliquely inserted on the basal margin of the outer wall of the basimere.

Adductor of the telomere: (Fig. Mp. 3; 11)

This relatively short, but strong muscle arises on the dorso-lateral aspect of the outer wall of the basimere, and is inserted on the inner basal angle of the telomere (tmr).

Abductor of the telomere: (Fig. Mp. 3; 12)

This muscle arises on the postero-lateral aspect of the outer wall of the basimere, and is inserted on the outer basal angle of the telomere (tmr).

V. Muscles of the genital chamber and its endoskeleton:

Ventral-lateral dilator of the genital chamber: (Fig. Mp. 3; 13)

This ribbon-like muscle arises on the ventro-lateral aspect of the ninth sternum, and is inserted postero-laterally on the membranous genital chamber.

Postero-dorsal dilator of the genital chamber: (Fig. Fig. Mp. 3; 14)

This short muscle arises ventro-laterally on the basal margin of the ninth tergum, and is dorsally inserted on the rod-like structure (r) approximately in the middle.

VI. Muscles of the intramittent organ:

Get promoter of the intramittent organ: (Fig. Mp. 4; 15)
This long muscle arises dorsolaterally on the outer wall of the cercus-like structure, and passing mesal to the rod (r) is inserted on the laterally compressed, double walled, antero-ventral extension (b) of the U-shaped portion of the endoskeleton of the genital chamber. This muscle also partly acts as an abductor of the cercus-like portion of the ninth tergum.

**Protractor of the intromittent organ:** (Fig. Mp.4; 16a, 16b)

This muscle consists of two bundles, viz., 16a and 16b which arise dorsally and ventrally on the inner surface of the large postero-dorsal extension of the endoskeleton (a) of the genital chamber, and are inserted on the postero-lateral surface of the apodeme of the intromittent organ (Apo).

**Retractor of the intromittent organ:** (Fig. Mp.4; 17)

This conical muscle arises on the anterior half of the rod (r), and is ventrally inserted at the base of the intromittent organ.

**Retractor of the intromittent organ:** (Fig. Mp.4; 18)

This broad muscle arises from the same portion of the rod (r) which provides insertion to the muscle No: 14, and is inserted on the postero-ventral edge of the postero-dorsal extension (a).
Mpt: Machimus (Tolmerus) *punjabensis* (Asilidae)