

THE MORPHOLOGY OF THE AEDEAGUS IN DELPHACIDAE
(HOMOPTERA)

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PLATES LXXXVII-LXXXVIII.

THE morphology of the male genitalia in the Homoptera has been dealt with by several authors during the last few years. The writer has used them extensively for systematic purposes, especially in the FULGOROIDEA. The most extensive work on this subject is by Dr. Hem Singh-Pruthi,* whose paper deals with both the Heteroptera and Homoptera.

In spite of all this work there is quite a number of morphological problems that await elucidation. The present paper discusses some of these in the family DELPHACIDAE.

1. *Asiraca clavicornis* (Fabr.). (Figs. 1-3.)

The aedeagus consists of a small, funnel-shape penis (*p.*) and a large periandrium (*pa.*). The inner wall of the penis is covered with small chitinous spines or scales; the apex of the periandrium bears long, curved spines. The apical portion of the periandrium is narrow, subtubular and slightly curved, the basal portion is much larger and flattened horizontally; the base is produced towards the anal segment as a large plate (the aedeagus basal support, *aed.b.st.*). The inner wall of the penis is continued through the periandrium as a strong, thick, chitinous tube, narrow at apex and gradually enlarging. This is Singh-Pruthi's sheath (*sh.*). As it passes out of the basal foramen of the periandrium (*bf.*) it enlarges into a chamber (*ch.*) which expands basally into a large shield-like body, the basal-plate bridge (*bp.br.*) and wings (*w.*). The dorsal wall of the chamber is membranous and a band of membrane passes across the middle of the ventral wall, thus making a membranous hinge which allows the aedeagus and sheath to move in a vertical direction. The sheath is thickest where it joins the chamber. A small sclerite near the base of the genital styles (basal plate) gives rise to a large apodeme (basal-plate prolongation, *bp.pr.*) which forms, or amalgamates with, the chamber to make the bridge (*bp.br.*). The ejaculatory duct (*ejd.*) enters the bridge near the basal-plate prolongation.

2. *Copicerus irroratus*, Swartz.

The aedeagus in this species is similar to that of *Asiraca* in its general plan but the details are distinct.

3. *Stenocranus agamopsyche*, Kirkaldy. (Figs. 4-7.)

In this species the periandrium is large, broad and flattened; the sheath is a long, thick-walled tube, slender until it passes through the basal foramen of the periandrium when it expands out into a large chamber, the dorsal wall and a transverse strip on the ventral wall being membranous; the chamber expands into a large shield or wing-like bridge; the basal-plate prolongation is large and meets the ventral wall of the chamber in the same manner as in *Asiraca*.

* *Trans. Ent. Soc. Lond.*, 1925, pp. 127-267, figs. 1-280.

4. *Columbisoga taiwanensis*, Muir. (Fig. 8.)

The periandrium is broad at the base, laterally flattened and narrowed and curved to the apex; a curved spine arises near the apex and a shorter one projects at right angles near the base of the curved spine. There is no chitinised sheath; the ejaculatory duct is difficult to recognise in the apical portion of the periandrium but in the basal half it is recognisable. The chamber is long, the apical portion firmly fastened to the dorsal or posterior margin of the base of the periandrium; the dorsal wall is membranous and a narrow hinge of membrane crosses the ventral wall. The bridge is well developed and the basal-plate prolongation is large.

5. *Iburnia blackburni*, Muir. (Figs. 9, 10.)

In this species there is no sheath; the chamber is mostly membranous with a strong and broad ring of chitin (fig. 9, *cr.*), which is soldered to the dorsal or posterior margin of the base of the periandrium. The bridge and its wing-like expansions are large and the basal-plate prolongation is strong and well developed.

6. *Iburnia halia*, Kirk. (Figs. 11, 12.)

The aedeagus' basal support forms a ring round the base of the periandrium. There is no sheath, but the membranous ejaculatory duct can be traced from apex to base. The chamber is similar to that in *Iburnia blackburni*, but the chitin ring is broader and touches the head of the basal-plate prolongation. The bridge with its expanded wings is typical.

7. *Perkinsiella graminicida*, Kirk. (Fig. 13.)

There is no sheath. The chamber is short and the apex of the broad basal-plate prolongation is soldered to the ventral or anterior margin of the base of the periandrium.

8. *Delphacodes neopropinqua*, Muir. (Figs. 14, 15.)

There is no sheath running through the periandrium. The chamber is similar to that in *Iburnia halia*, but the chitin ring is not so strong; the wings of the bridge are large.

9. *Saccharosydne*, Kirk, and *Neomalaxa*, Muir. (Figs. 16-18.)

The genera *Saccharosydne*, Kirk, and *Neomalaxa*, Muir (Figs. 16-18), depart from the normal type more than any so far described. The periandrium is of extreme length and thinness with thin walls; a sheath with thick, flexible, translucent walls passes from end to end. This long, slender aedeagus when at rest is coiled up in a large invagination (*gi.*). In a former description of this insect the writer stated that there was practically no aedeagus but that there was a long, slender, coiled internal structure of unknown use. This mistake was made on account of the very slender walls of the invagination and its large muscular covering. On having old, cabinet specimens for examination, it was difficult to clear the tissue away without breaking the walls. In *Saccharosydne saccharivora* (Westw.) the aedeagus has a small spine at the base of the periandrium (Fig. 18), which is considered as the aedeagus. The chamber is long, the apex of the basal-plate prolongation forming its ventral wall; the wings of the bridge are large. *Neomalaxa flava*, Muir (Figs. 16 and 17), the basal-plate prolongation and chamber form a curve, but the general structure is similar to that of *Saccharosydne*.

In the ten species mentioned above we have very different types of aedeagus. How far these types will cover the whole family it is not possible to say,

the writer has dissected about three hundred species of DELPHACIDAE and so far they are modifications of the types described above.

In the interpretation of the morphology there is room for considerable differences of opinion. Dr. Singh-Pruthi considers the basal plate (or plates), the basal-plate prolongation, the bridge and its wings, the chamber and the sheath as one morphological unit, and he states that the ejaculatory duct passes through the bridge, chamber and sheath till it enters the vesica (penis). If this interpretation could be demonstrated it would be of great interest, for nowhere else in insect morphology does an apodeme form such complex structures. The nearest approach would be the tentorium of the head, which is formed by three pairs of apodemes or invaginations. Unfortunately Dr. Singh-Pruthi does not produce any definite evidence to support his view, and only a study of development will definitely settle the question.

The writer cannot accept the above interpretation chiefly because he has been unable to trace the ejaculatory duct through the chamber and the sheath. Many mounted specimens have been examined under high powers ($\times 1800$), some of them stained, but he has failed to trace any signs. His interpretation is that the sheath is the thickened and chitinised ejaculatory duct, and the chamber an enlargement of the ejaculatory duct. The basal-plate prolongation is an apodeme of the basal plate, and the bridge and wings are formed by the soldering together of an expansion of the apex of the basal-plate prolongation and an expansion, flattening out and chitinisation of the chamber or ejaculatory duct.

That the bridge and wings form a composite structure can be seen in many of the specimens examined. In one specimen of *Iburnia blackburni* it is possible to see an optical section through the middle, and in this it is possible to trace the expansion of the chamber (fig. 10), and the ejaculatory duct as a continuation of the chamber (fig. 10, *ejd.*). In many, if not all DERBIDAE there is no basal plate or prolongation, and the chamber and wings are formed from the ejaculatory duct alone.

Figure 19 represents diagrammatically the arrangement of the structures according to Dr. Singh-Pruthi, and figure 20 the same according to the writer. A study of development may eventually show which of these interpretations is correct.

EXPLANATION OF PLATES LXXXVII-LXXXVIII.

PLATE LXXXVII.

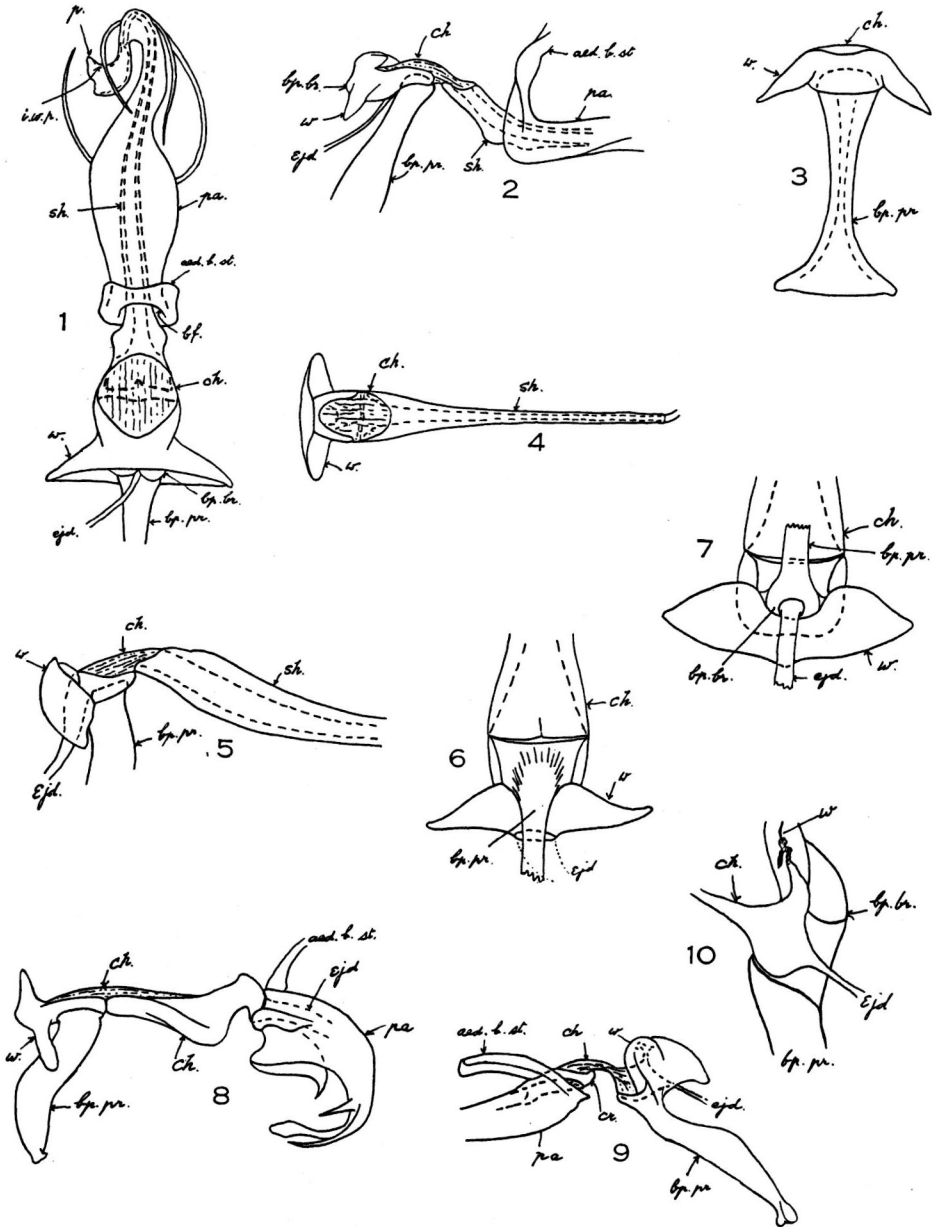
- FIG. 1. *Asiraca clavicornis*, dorsal view of aedeagus, chamber and basal-plate prolongation.
2. *Asiraca clavicornis*, lateral view of same.
3. *Asiraca clavicornis*, basal-plate prolongation with chamber and wings.
4. *Stenocranus agamopsyche*, dorsal view of sheath and chamber.
5. *Stenocranus agamopsyche*, lateral view of same.
6. *Stenocranus agamopsyche*, ventral view of chamber and wings.
7. *Stenocranus agamopsyche*, end view of same.
8. *Columbisoga taiwanensis*, lateral view of male aedeagus.
9. *Iburnia blackburni*, lateral view of base of aedeagus, chamber and basal-plate prolongation.
10. *Iburnia blackburni*, diagrammatic optical section through basal-plate bridge and wings.

PLATE LXXXVIII.

- FIG. 11. *Ilburnia halia*, lateral view of aedeagus, chamber and basal-plate prolongation, and bridge.
 12. *Ilburnia halia*, view of basal-plate bridge and wings.
 13. *Perkinsiella graminicida*, lateral view of aedeagus, chamber, wing and basal-plate prolongation.
 14. *Delphacodes neopropinqua*, the same as above.
 15. *Delphacodes neopropinqua*, view of wings, bridge and basal-plate prolongation.
 16. *Neomalaxa flava*, lateral view of male genitalia.
 17. *Neomalaxa flava*, lateral view of the basal and apical portion of periandrium, the chamber, wings and basal-plate prolongation.
 18. *Saccharosydne saccharivora*, lateral view of base of periandrium, the chamber, wings and basal-plate prolongation.
 19. Diagrammatic representation of structure according to Dr. Singh-Pruthi.
 20. Diagrammatic representation of structure according to Muir.

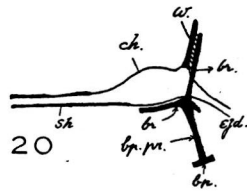
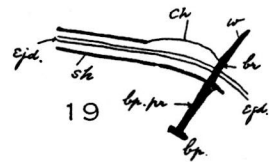
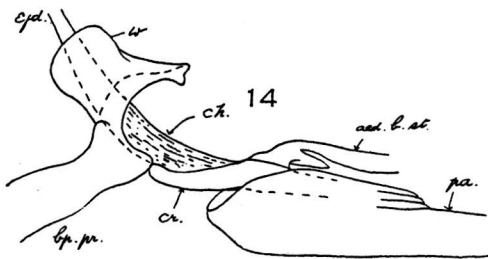
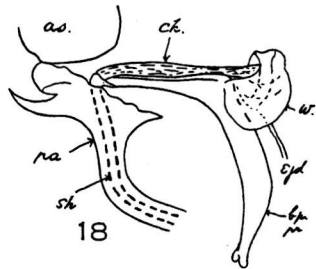
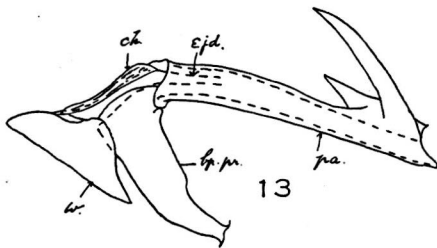
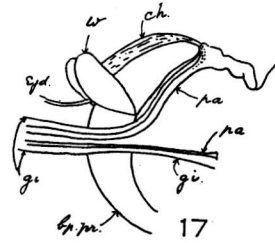
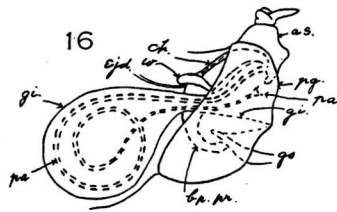
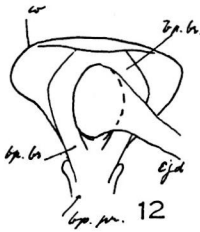
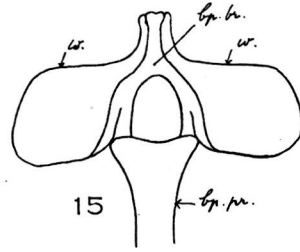
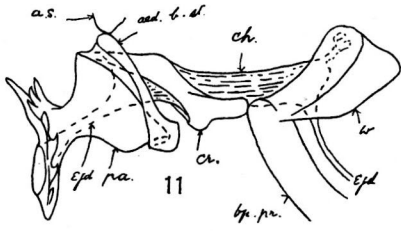
LETTERING OF FIGURES.

<i>aed.b.st.</i>	. . . aedeagus basal support.	<i>ejd.</i>	. . . ejaculatory duct.
<i>as.</i>	. . . anal segment.	<i>gi.</i>	. . . genital invagination.
<i>bf.</i>	. . . basal foramen.	<i>gs.</i>	. . . genital style.
<i>bp.br.</i>	. . . basal-plate bridge.	<i>i.w.p.</i>	. . . inner wall of penis.
<i>bp.</i>	. . . basal plate.	<i>p.</i>	. . . penis.
<i>bp.pr.</i>	. . . basal-plate prolongation.	<i>pa.</i>	. . . periandrium.
<i>br.</i>	. . . bridge.	<i>pg.</i>	. . . pygofer.
<i>ch.</i>	. . . chamber.	<i>sh.</i>	. . . sheath.
<i>cr.</i>	. . . chitin ring.	<i>w.</i>	. . . wing.



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