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Sawfly Genitalia: Terminology and Study Techniques

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During the past two decades several hypotheses have been advanced regarding the derivation and homologies of parts of sawfly genitalia, including the genital capsule of the male and the saw of the female. The proponents of each hypothesis have frequently indicated a preference for a new or modified terminology to be applied to the various parts. In the development of the taxonomy of the sawflies, characters of both male and female genitalia have assumed continually greater importance in evaluation and diagnosis of both genera and species. With this development there has arisen a need for a stable terminology for parts of the saw and male genital capsule, a set of names which are uninomial for easy use, which apply definitely to the various parts as they exist in the group, and which can be applied by both taxonomist and morphologist regardless of differing theories of evolutionary development.

A terminology is here presented which has been designed to fill this need. The names have been selected on the following basis: (1) elimination of homonyms, that is, identical names which have previously been used for some other part of the insect body; (2) priority of uninomial latinized names, with the elimination of phrases, as a designation for well-defined morphological units; (3) tempering consideration of priority with weight of usage over a long period, or with application of a term to a homologous structure in several insect orders. The resultant terminology for the male genitalia agrees in many respects with that proposed by Crampton (1919) as enlarged

by Peck (1937), with the addition of a few names for certain parts. Many of the more recent terms proposed by Snodgrass (1941) are antedated by other available names. The terminology of the saws is a modification of that proposed by Ross (1929).

Terminology

Male Genitalia, figs. 1–5

The genitalia of male sawflies form a well-organized capsule, in repose retracted within the apical segments of the abdomen. The capsule articulates with these segments by means of a flexible membranous tube. Primitively the surface bearing the volsellae or ossicles is ventral; in certain groups, however, soon after adult emergence, the genital capsule undergoes a twisting of 180° so that this surface becomes dorsal. It is therefore convenient to orient surfaces in relation to the volsellae; the surface bearing them is the *ossicular* side, the opposite the *abossicular* side.

The genital capsule, figs. 1 and 2, is divided into four principal parts, a gonocardo, gonoforceps (paired), volsella (paired), and aedeagus. The latter three are subdivided further.

Gonocardo (*gc*).—This sclerite forms a ring around the base of the capsule. *Basal ring, cardo,* and *lamina annularis,* are other terms which have been used by various authors.

Gonoforceps.—Arising above the gonocardo is a pair of lateral clasper-like appendages. Each is a *gonoforceps.* In most sawflies the apical portion forms a distinct, articulated segment, *h,* the *harpes,* and the basal portion forms the major sclerite of the capsule, the *gonostipes* (*gs*). In some families the end of the harpes has a membranous suction organ, the *gonomacula* (*gm*). In many forms the mesal margin of the primary dorsal (abossicular) surface of the gonostipes is produced into a definite lobe, the *parapenis* (*pp*); the two opposing parapenes are partially fused at least at the base; this structure formed by the two parapenes is termed the *praeputium.*

Volsella, fig. 3.—On the primary ventral surface of the capsule is a pair of structures, separate on the meson, but each

joined laterally by membrane to the gonostipes, and frequently appearing to be implanted on their mesal surface. Each of these structures is a *volsella* (*v*). The flat basal portion of the volsella which is contiguous with the membranous edge of the gonostipes is the *basivolsella* (*bv*). The apex of the volsella bears two definite lobes, projecting beyond any membranous connection with the gonostipes, (1) a lateral *distivolsella* (*dv*) which is an unjointed continuation of the basivolsella, and (2) a mesal *gonolacinia* (*gl*), which usually articulates by a narrow membranous hinge with the basivolsella. The gonolacinia has an apical portion or *apiceps* (*ap*) and a basal prolongation or *basiura* (*ba*). The basivolsella has a longitudinal thickening, the *volsellar strut* (*vs*) ; its apex marks the point of closest articulation between basivolsella and gonolacinia. Snodgrass (1941) has pointed out that the distivolsella and gonolacinia are opposable, like thumb and forefinger, and function as accessory clasping organs. He proposed the names *crespis volsellaris* and *digitus volsellaris* for these two parts, respectively, but Peck's (1937) names *distivolsella* and *gonolacinia* have priority. Both writers have shown that several workers, including myself, have used the term *sagitta* erroneously for the gonolacinia. Sagitta should be restricted to the lateral sclerotized processes of the aedeagus in Apoidea.

Aedeagus (*ae*).—In the sawflies this central structure is divided into a pair of long *penis valves* (*pv*) ; their apex is hinged by membrane along the primary dorsal surface, but the primary ventral edges are free. Crampton proposes *penisalva* for penis valve; if a latinized term is desired, this should be employed. The term penis valve, however, has been adopted generally by almost all workers in the field.

It seems desirable at this time to propose names for certain distinctive areas of a penis valve. Each penis valve, fig. 4, has a lateral projection or *ergot* (*e*), for muscle attachment. Basal to the ergot is a tail-like portion, the *valvura* (*vr*), attached to the capsule by both muscle and membrane; beyond the ergot is the head like portion, the *valviceps* (*vc*). The valviceps has a sclerotized mesal thickening or *valvar strut* (*vv*) and may be

highly ornamented with teeth or folds. In some genera of Nematinae, fig. 5, it is definitely subdivided at the apex into a mesal flap, the *pseudoceps* (*pc*), and a lateral flap, the *paravalva* (*pr*). The latter bears at its apex a spine or spur, the *valvispina* (*va*).

Female Saw, or *Ovipositor*

The functional units of a typical sawfly ovipository apparatus have been illustrated by Snodgrass (1935, fig. 317). They consist of two pairs of valvifers which are attached to the ninth tergite and which give rise to the other parts; a saw formed by two pairs of articulated processes, one arising from each valvifer; and a sheath composed of a pair of appressed end segments of the second valvifers. The second valvifers and sheath together form a protective structure into which the hinged saw is retracted when not in use. The sheath may function also as a brace during oviposition. The sheath and saw exhibit many useful taxonomic characters.

The sheath is usually simple in structure, each half flat or convex. In certain groups there is a flange-like projection extending along the apico-ventral margin. This flange, or *scopa,* is greatly developed in the Argidae and in many genera appears to form the edge of the sheath; the primary edge is hidden within the opposed scopae.

The saw.—The dorsal pair of blades (each is a *lance,* fig. 7) are processes of the second valvifers; the ventral blades (each a *lancet,* fig. 8) are processes of the first valvifers. Along at least part of the dorsum the two lances are tightly joined by membrane or fused solidly. On each side the lance and lancet are joined together by long rod-like interlocking grooves, or *virgae* (*vi*). The virga of the lance is situated near the ventral margin on the lateral surface; the virga of the lancet is situated on the inner surface near the dorsal margin. These allow the lancet to slide back and forth. The lances are articulated at the base and swing in an arc from this stationary pivot point. At their base the two lancets are joined by membrane to a triangular external plate, or *ligamentum,* which allows some movement of the lancets back and forth under the lances.

The *lance,* fig. 7, is divided into segments by seam-like *sutures* (*s*). The large basal segment, or *radix* (*ra*), bears the articulation with the valvifer. The apical blade-like portion or *lamnium* (*la*) is usually simple in structure, with 10 to 30 segments.

The *lancet,* figs. 6 and 8, has a long membranous *radix* (*ra*) bearing the dorsal sclerotized virga and a ventral sclerotized cord or *tractium* (*tr*); this latter is frequently enlarged where it connects with the ligamentum, the enlarged portion forming a heel plate or *tangium* (*ta*). The apical portion forms the *lamnium* (*la*) which is divided by sutures into definite segments. The ventral margin of each segment usually forms a definite toothed *serrula* (*se*). Each *suture* (*s*) may bear a comb-like row of spines to form a *ctenidium* (*ct*), or a wing-like projection or *ala* (*a*). The ala usually terminates ventrad in a spur, the *alaspicula* (*ad*), and may bear small spines or *alaspinulae* (*ac*) on its free edge. Near the ventral margin there is frequently a definite spur, the *spiculella* (*sr*); between spiculella and alaspicula may be a group of *subalar spines* (*sa*). The sclerotized ventral border of the blade is the *sclerora* (*so*), which is traversed in each segment by one or more pores; a section of the sclerora between two pore groups may be termed an *abscissa* (*aso*). The membrane on the mesal side of the lancet usually forms a long crease, or *crepidium* (*cr*); frequently this terminates basally in a sclerotized tongue or *examium* (*ex*).

Study Techniques

Sawfly male genitalia and saws can be studied to the best advantage if removed from the specimen and cleared. For this, use specimens which have been killed dry, pinned, and allowed to harden for at least two weeks. These can be relaxed in a damp sand-carbolic acid relaxing chamber. The male genitalia may be extracted with a needle, the saws cut out with a pair of very fine optical scissors. With the saws, care must be taken to make the cuts at the extreme base of the saw in order to obtain a complete preparation. Preparations clear readily