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XIV

A STUDY OF THE TERMINAL ABDOMINAL STRUCTURES OF MALE DIPTERA (TWO-WINGED FLIES)

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This paper was written as a part of the requirements for the degree of doctor of philosophy at Stanford University, and I wish to express my thanks to Professors R. W. Doane and G. F. Ferris of the Department of Entomology in that University for their helpful suggestions and aid in many ways during the progress of the investigations. The original manuscript and the drawings were sent to Dr. G. C. Crampton of Massachusetts Agricultural College, and I am greatly indebted to him for reading over the manuscript and suggesting many important changes. In the original manuscript I had followed Berleze and Metcalf in numbering the abdominal segments (allowing for a hypothetical first segment fused with the thorax) but I am now converted to the view held by Dr. Crampton. The genitalia are therefore considered to be on the ninth abdominal segment, any fusion of segments occurring at the apex of the abdomen.

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and the guards near the base furnished with tufts of spines (fig. 279).

In *Sinophthalmus pictus* the genitalia are like those in the preceding species in general character. There is a considerable reduction in the chitinization of the basal part of the abdomen and a remarkable reduction of the ninth segment. The eighth segment is apparently lost or fused and the seventh fused with the sixth, the line of division being visible in cleared specimens. The apodemes are well developed. The genitalia are shown in figure 278.

Family Geomyzidæ

In *Geomyza lurida* Loew the first apparent segment is the fused first and second, there being four other large tergites in the preabdomen, and the ninth segment is large; the seventh and eighth segments are fused with other segments or are lost. The ædeagus is most unusual, parts of it being chitinized in a complex, yet symmetrical manner (fig. 280), the rest hyaline when cleared; judging from the form the ædeagus can evidently be telescoped. The interior forceps and "palpi" are not developed; the double apodeme is small and slender. The cerci are large and rather pointed.

In *Cerodontha dorsalis* Loew the sternites are very small, the number and arrangement of the segments being about as in the preceding species. In *Tethina coronata* Loew the ædeagus is very unusual; it is rather large, with a slender geniculate basal portion which is chitinized, and an apical part which is membranous, greatly enlarged, and bulbous in form; the basal portion has a dense covering of erect hairs longer than its own diameter. The cerci are rather small and membranous.

Family Agromyzidæ

In *Agromyza æneiventris* Fallén the abdomen is about the same as in the Geomyzidæ, being composed largely of segments one to six, with the genital portion rather small. There is only one segment between the sixth and ninth, probably the eighth. The ædeagus and apodemes are well developed (fig. 282), the ædeagus being quite complex on the apical portion.

There are no separate styles on the ninth segment. The cerci are well developed.

In *Phytomyza obscurella* Fallén segments one and two are fused and segments 3-6 make up most of the rest of the abdomen. The seventh segment is apparently lost. The ædeagus in this species is one of the most complex seen in the study of the dipterous genitalia (fig. 284), and there is an immense double apodeme for the attachment of the muscles which control this organ. In *Agromyza scutellaris puella* Meigen the ædeagus is quite simple; the apodeme is rather long and slender and relatively smaller than in *P. obscurella*.

Mr. J. R. Malloch has recently figured the hypopygia of several species of *Leucopis* in a paper on the subfamily Ochthiphilinæ (Bull. Ill. Nat. Hist. Survey, vol. 13, art. 14, 1921). The genitalia possess good specific characters. The cerci are small but distinct. The ædeagus is apparently quite variable; it is very long, chitinized and curved in *L. piniperda* Malloch, much shorter in the other species. The ninth tergite is well developed but the surstyli are small or rudimentary. *L. griseola* Fallén has the interior forceps and "palpi" well developed; the ejaculatory apodeme in this species is large and broad, not slender as in the species of *Agromyza* (fig. 283). In *L. bella* Loew the apodeme is much smaller, the ædeagus relatively larger and shorter, with an apical slender portion differentiated from the rest; the interior forceps and "palpi" are nearly the same as in *L. griseola*. In a large undescribed species from Arizona the interior forceps, "palpi" and ædeagus all project about the same length from the floor of the ninth segment and all are protected by the slender arms of the ninth tergite; the apodeme in this species of *Leucopis* is of the same general shape as in *L. griseola*.

Family Milichiidæ

In this family (included by some as a subfamily in the Agromyzidæ) there is not the great development and specialization of the ædeagus seen in the Geomyzidæ and Agromyzidæ, if one can judge from the three species examined. *Madiza halteralis* Coquillett is heavily chitinized and the segments one to six make up most of the abdomen; the genital portion of the abdomen is extremely small, the seventh and eighth segments

greatly reduced or lost and difficult to make out in the forms studied. The whole genital portion of the abdomen is normally drawn into the sixth segment or under the sixth tergite. The outer claspers are tergal and therefore are surstyli; they are relatively large, simple, and close over the internal parts. In *M. halteralis* the ends of the styles are broad and toothed on the margin; in this same species the double apodeme is small, slender, and can be made out only under high magnification; the ædeagus is minute and there is probably an extensile membranous portion.

In *Milichia leucogaster* Loew the sternites are reduced to very narrow strips, the sixth sternal segment largest and hollowed out posteriorly; the pleural membranous area is large. The seventh and eighth segments have disappeared and the hypopygium is relatively very small. There are two long styles on the ninth tergite, the surstyli (fig. 281). On the anal segment there are two long spines, one on each of the rudimentary cerci. The double apodeme is fused with the genital arch.

Milichiella nitida Hendel has much the same plan of construction as *M. leucogaster*. The sixth tergite is very large in comparison with the rest of the abdomen and the sternites are relatively larger than in the preceding species. The proctiger is different from *M. leucogaster* and lacks the two long spines. The surstyli are longer, more slender and not enlarged at the tips; the double apodeme is smaller. There are small spines near the base of the ædeagus, probably representing the interior forceps and the palpi.

Family Hippoboscidæ

In *Olfersia americana* Leach the abdomen is largely membranous and the segments can be located by the presence of spiracles, of which there are seven pairs; one pair of spiracles is at the extreme base of the abdomen, the second pair in the chitinous base of the abdomen (the second segment), three pairs in the membranous area along the sides of the abdomen, but in a tergal position, the last two pairs in the anal region; the sixth spiracle is actually posterior to the seventh, which is moved up on the dorsum not far from the anal opening. The ædeagus, at least the intrommitant organ,

which may not contain the true penis is long and sharp. The genital styles, according to my interpretation, are represented by bristly knobs and are located on each posterior corner of the genital opening. In this case the interior forceps are the long, slender, style-like appendages which point back and have a heavy framework at the base. The double apodeme is large and easily seen in cleared specimens. The anal area has a flap, bristly on the margin, and the opening of the genital organs at the tip of the abdomen is also the anal opening (cloaca).

Lipoptena subulata Coquillett has genitalia of the same general character as in the preceding species. The abdomen is membranous except for a poorly chitinized anal plate. In *L. mazamæ* (Rondani) the ædeagus is short, scarcely projecting beyond the genital opening, the interior forceps a little longer. The framework at the base of the interior forceps reaches to the basal third of the abdomen. The styles are represented by very small chitinous areas over the interior forceps, with two long spines and two shorter ones; the interior forceps are blunt. In *L. traguli* Ferris and Cole the last five spiracles are all near the apex of the abdomen, the third pair about opposite the base of the interior forceps.

In *Melophagus ovinus* the genitalia are much the same as in *Olfersia americana*. The ædeagus is slightly longer than the interior forceps and is blunt. The spiracles are of great size, the first and second pair near the base of the abdomen, the sixth and seventh near the apex of the abdomen, below the anal opening; they are pulled around to the ventral side of the abdomen but are really tergal in location.

Family Streblidæ

There is less evident segmentation of the abdomen here than in the Hippoboscidæ. In *Paradyschiria fusca* Speiser the outer styles are reduced to small strips on the sides of the genital opening. The inner claspers (probably interior forceps) are long and point backwards. The ædeagus is long, slender, thick at the base and quite distinctive in shape; the apodemes are well developed. Most of the structures are internal and the specimens must be cleared to see the construction. The ejaculatory apodeme is almost as large as the double apodeme.

276. *Gymnopa tibialis* Cress., ventral view of genitalia.
277. *Meromyza flavipalpis* Mall., ædeagus and adjacent structures.
278. *Sinophthalmus pictus* Coq., lateral view of hypopygium.
279. *Scaptomyza terminalis* Loew, lateral view of hypopygium.
280. *Geomyza lurida* (Loew), lateral view of abdomen.
281. *Milichia leucogaster* Loew, ventral view of genitalia.
282. *Agromyza æneiventris* Fall., ædeagus and appendages.
283. *Leucopis griseola* Fall., lateral view of genitalia.
284. *Phytomyza obscurella* Fall., ædeagus and appendages.
285. *Nycteribia pedicularia* Latr., ventral view of genitalia.
286. *Nycteribia biarticulata* (Herm.), ventral view of genitalia.
287. *Olfersia americana* (Leach), ventral view of genitalia.