XII. *The Male Abdominal Segments and Aedeagus of* Habrocerus capillaricornis *Grav.* [Coleoptera, Staphylinidae].

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Plate XX.

In 1911 Dr. L. Weber,* in an interesting paper, described and figured the male genitalia of a number of species of Staphylinidae, *Habrocerus capillaricornis* Grav., being among them. The figures and description of this species show that it departs so greatly from the normal Staphylinid type that the homologies of the terminal abdominal segments and the aedeagus are not easily recognised. While Dr. Weber is correct in the main points, there are certain others which we consider of importance, such as the recognition of the membranous condition of the aedeagus, which he does not mention, and some of his interpretations we do not agree with. For these reasons, and for the interest attaching to the departure of a species from the normal type of a very large group of which it forms part, the following notes are published.

In all the male Staphylinidae which we have examined with this one exception there are nine abdominal segments and an aedeagus. The first tergite is in intimate relation with the metanotum, the lateral portion being longer than the middle and including the first abdominal spiracle, which is sometimes very large; the second tergite, which is often short, and the following seven are well defined. The first two sternites are mostly membranous and modified to accommodate the hind coxae (as is the rule in the Coleoptera); the following seven are well defined. The hind margin of the eighth sternite is emarginate in some species. Each of the first eight abdominal segments bears a spiracle. The eighth segment, in many species, is attached to the seventh by a large membrane, which allows of the former being drawn within the latter. The ninth segment is modified and differs considerably in different genera; it is attached to the eighth by a considerable membrane, which allows of great mobility.

* "Fests. Ver. Nat.," Cassel, 1911, pp. 284–313.

In *Tachyporus solutus* Erich., the ninth segment (figs. 1, 2, 3) consists of four pieces, a large ovate sternite (IX), a pair of large subtriangular pleural plates (*pp*) meeting together on the dorsal aspect and overlapping the basal portion of the tergite (9) and connected by a slender strip on the ventral aspect, and a large dorsal plate whose basal area is overlapped by the pleural plates. In *Leistotrophus* we find a similar arrangement of segments, but the ninth differs considerably (figs. 4, 5). The pleural plates (*pp*) are small and each bears a large style (*s*), on the ventral aspect they are connected by a narrow strip and on the dorsal aspect they are widely separated by the large tergite; a pair of large glands open on the connecting membrane (*a*) between the eighth and ninth tergites.

What is here considered as the ninth tergite is considered by some writers as the tenth tergite, but we can see no morphological reason for considering it so, and we have no information as to its ontogeny. The anus opens beneath the ninth tergite on a membrane which connects the aedeagus with the ninth segment (*im* 1).

Without entering into a comparative study of the ninth abdominal segment we can consider the two mentioned as typical of the Staphylinidae.

In *Habrocerus capillaricornis* Grav., the first tergite is well defined, between it and the second there is a fairly large membrane, the second and five following tergites are well defined. The first two sternites are small and membranous, the following five are well defined. The seventh segment is connected by a large membrane to the sixth some distance from its posterior edge, which gives the seventh great mobility and allows of it being completely withdrawn into the sixth.

The eighth segment (VIII in figs. 6, 7, 8, 9) is highly modified and consists of four pieces. A large pair of pleural plates (*pp*), on which the eighth spiracles (fig. 6, *sp*) are situated, embrace the lateral area, and from the apex of each a large, spine-like style arises; the dorsal aspect consists of a very short tergite (8), and the sternite (VIII) consists of a large plate more heavily chitinised round the edges, the posterior portion is external and visible and has a small emargination in the middle, the rest of the sternite is internal. The lateral portion of the eighth tergite articulates with the lateral edges of the sternite and also articulates in a depression at the base of the pleural plates. The

eighth segment is attached to the seventh by a large membrane (*b*) and can be completely withdrawn into it. The ninth segment is highly modified and shaped like an oat (fig. 11). The distal and visible portion consists of a pair of pointed and slightly curved lobes connected in a V-shaped piece on the dorsal aspect; the basal and internal portion consists of a membranous plate (*f*) chitinised along the edges (*g*). On the ventral aspect at the meeting of the lobes there is a small trident body (figs.6 and 10, and 11 *t*) attached to a rod (*d*) which lies free within the segment. The segment is attached to the preceding by a membrane (*c*), which allows of considerable play between the pleural plates of the eighth segment. The anus (*an*) opens on a membrane between the lobes; the rectum can be protruded. In figure 9 it is shown retracted and in figures 7 and 11 protruded.

For the sake of those who may not be acquainted with the male genitalia of the Staphylinidae it may be stated that in the more generalised forms, e.g. *Gyrophaena pulchella*, the median lobe is long, cylindrical, with the median foramen at the basal extremity and the median orifice at the other, the internal sac is small and undifferentiated and the tegminal lobes large. The line of specialisation is for the basal portion of the median lobe to become large and the distal portion shorter, the median foramen to move along the medio-ventral line towards the median orifice till they are separated by only a very narrow area and for the tegminal lobes to be greatly reduced; a good example of this specialisation is found in *Xantholinus glabratus*. The internal sac in these more specialised forms is large, complex and often bears a highly developed armature. In these forms the median lobe is a beautifully adapted bulb for the evagination of the internal sac by blood pressure. The ventral aspect is highly chitinised, also the dorsal aspect, but not so strongly; a band of membrane connects the two; muscles attach the dorsal surface to the ventral portion, and by their contraction the dorsal surface is depressed and the pressure exerted on the fluids within the bulb ejects the sac. In freshly dissected specimens this can be accomplished artificially by slight pressure on the dorsal surface of the bulb.* In all species in which the internal sac is specialised (and they include the largest

* For fuller details of this subject the reader is referred to Trans. Ent. Soc. Lond. 1912, pp. 477 *et seq.*

portion of the Coleoptera), it is the chief functional organ, the tegmen and median lobe serving for its protection, guidance and protrusion.

In *Leistotrophus* the basal portion of the median lobe forms but a small bulb, and the distal portion is comparatively large; in *Tachyporus* the bulb is much larger and the distal portion smaller. The connection with the inner surface of the ninth segment is by a membrane arising around the edge of the median foramen; the anus opens on the dorsal portion of this membrane (fig. 3, *im 1*; in this figure the aedeagus is shown drawn out of this membrane in a diagrammatic manner impossible to do in nature).

In *Habrocerus capillaricornis* there is nothing to correspond to the highly developed median lobe of *Leistotrophus* and *Tachyporus*, but the internal sac is well developed and specialised (*is*). In the place of the median lobe we find a membranous tube opening in the dorsal aspect of the small trilobe process (figs. 10 and 11, *t*), on the same membrane as the anus is situated. This tube enlarges coneshape and is inflexed (*h*) for a short distance and then reflexed (*i*), this reflexion continuing as the internal sac; the inflexed membrane (*tg*) is in close contact with the outer membrane (*im 1*), and there is a small, semichitinised, triangular plate (*e*) at the point of inflexion. The outer membrane (*m 1*) is homologous in position to the connecting membrane (*im 1*) of *Tachyporus* and *Leistotrophus* and the inner, inflexed membrane (*tg*) with the aedeagus.

The internal sac (fig. 12, *is*) is large and covered with small spines pointing basad; along one side there is a row of nine spines fixed to the sac by large bases; the apical three are smaller than the others; along the opposite aspect there is a row of small semitriangular plates, one overlapping the other.

The membranous cone (fig. 10, *im 1*, *tg*) varies somewhat in size in different specimens, the one figured is very distinct, but others are smaller and not so plain. In the absence of fresh or spirit specimens certain important points relating to the musculature have to be left unexplained, but there is a large group of muscles attached to the margin of the cone (fig. 10, *h*) enveloping the internal sac. This evidently acts as a muscular bulb in a somewhat similar manner to the muscular bulb in certain Lamellicornia (i.e. *Melolontha vulgaris*). There are several points in the structure of the

membranous aedeagus which require further investigation, but as the opportunity for carrying on the work will not occur for an indefinite period we consider it advisable to publish the results as they now stand.

That this species presents profound modifications on what is generally recognised as the normal Staphylinid morphology must be admitted by all students of this group, but unfortunately we have very slight knowledge of the morphology of this large group, and so we can only blindly speculate as to the line of evolution it travelled to reach its present condition.

The theory that nine well-developed abdominal segments and a well-defined aedeagus is the older type is founded upon good morphological reasons, but forms having once arrived at a certain stage of specialisation, such as exists in all presently known species, are not likely to undergo a profound modification. It is therefore early in the phylogeny of the group that *Habrocerus* must have started on its line of specialisation. It is possible that further research will reveal forms that will show us some of the stages of this evolution, but until then it will be safest to consider that the genus is very distinct from all the other Staphylinidae which we know and must have been so from a very remote period in the evolution of the family.

Figure 12 is from a drawing by my wife, who everted this sac and mounted it when working with Dr. David Sharp.

Explanation of Plate XX.

Fig. 1. Ventral view of ninth abdominal segment and aedeagus of *Tachyporus solutus* Erich.

2. Dorsal view of the same.

3. Lateral view of right side of the same.

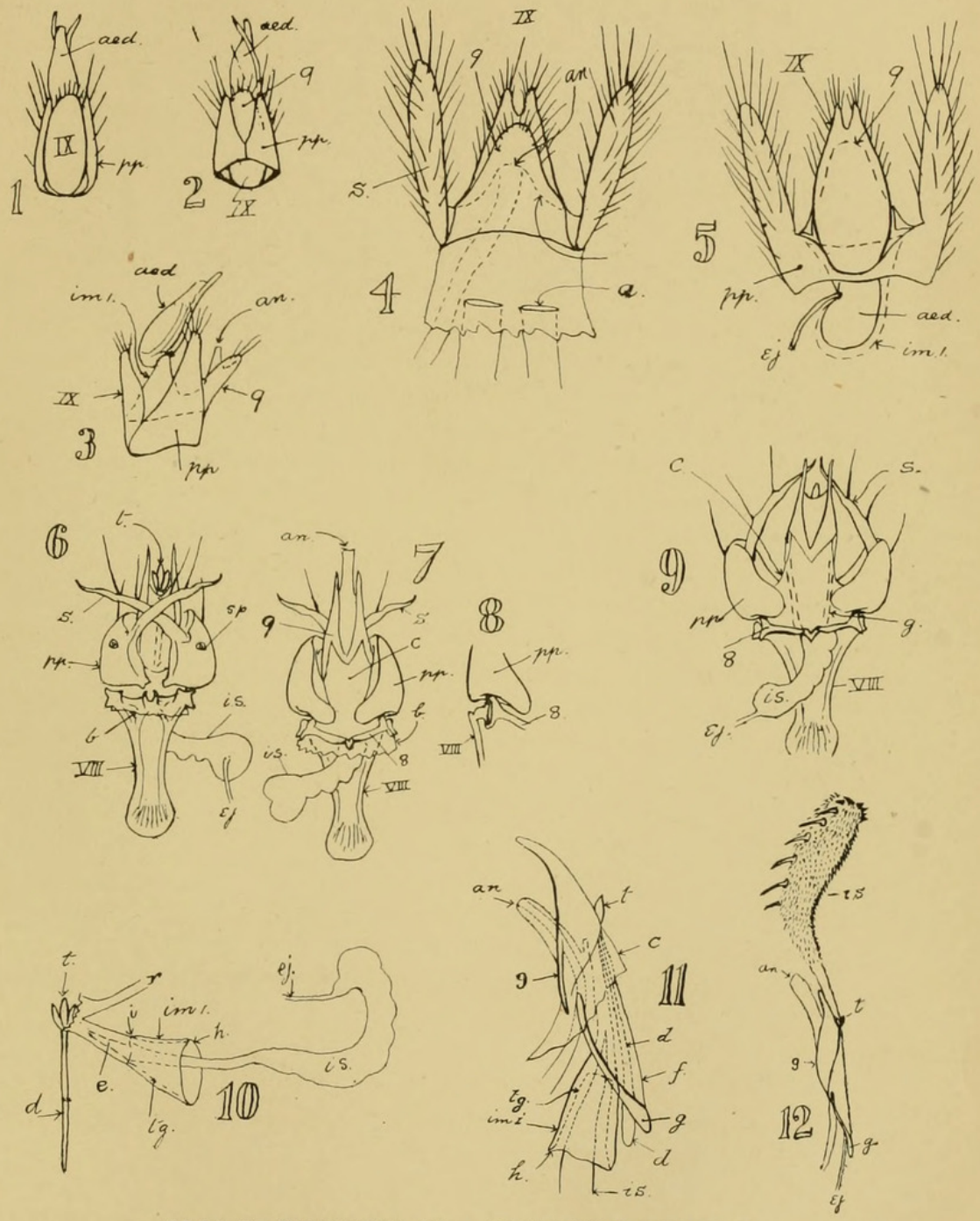
4. Dorsal view of the ninth abdominal segment of *Leistotrophus* sp.

5. Ventral view of the same.

6. Ventral view of eighth and ninth abdominal segments of *Habrocerus capillaricornis* Grav.

7. Dorsal view of the same.

8. Articulation of eighth tergite and eighth sternite and the pleural plate.



MALE GENITALIA. STAPHYLINIDAE.