

the origins of muscles No. 10 are situated on the part of pretergum of the third segment (Fig. 18). In the ponerine tribe Ponerini, although the pretergum and presternum of the fourth segment are developed, the muscles No. 10 are inserted on the exterior-lateral edges above the apodemes of the tergum of the fourth segment, and the muscles No. 8 originates from the posterior part of the tergum of the third segment, like in the ground plan of aculeates (Figs. 22, 23 & 26).

Discussion

Functional morphology

In the ground plan of aculeates, a downward movement of the abdomen is effected by both tergal protraction (relaxation of the muscles Nos. 1 & 8) and sternal retraction (contraction of the muscles Nos. 5 & 12), where the muscles Nos. 3 and 10 serve as the pronators of the tergum (Fig. 34). In Tiphidae, Mutillidae, Scoliidae, Formicidae and Vespidae, the anterolateral parts of the pretergum of the third abdominal segment protrude downward beyond the pretergosternal junction, and the pretergum is immovably connected with the presternum. Because in these aculeates the contraction of the muscles No. 3 lifts up obliquely the lowest point of presclerites of the third segment, the muscles No. 3 change the role from the pronators to depressors of the abdomen (Fig. 35). In Tiphidae, Mutillidae, Scoliidae, Formicidae and Vespidae, the muscles No. 1 also change the function from tergal retractors to levators of the abdomen, because the contraction of the muscles No. 1 pulls the upper part of pretergum associated with the presternum of the third segment into the posterior foramen of the second segment (Fig. 35).

Although Myrmicinae, Cerapachyinae and the ponerine tribe Proceratiini have the presternum of the third segment ventrally bulging below the lowest margins of the pretergum, muscles No. 3 also serve as depressors of their abdomen. Because the pretergum of the third segment enclosed immovably the presternum, the contraction of the muscles No. 3 provides forces for their abdominal downward movement by lifting up obliquely the lower part of the third segment (Fig. 5).

Myrmicinae, Pseudomyrmecinae, Cerapachyinae, Myrmeciinae and the ponerine tribe Amblyoponini and Ectatommini have the development of presclerites on the fourth segment. In these formicids, the muscles of Nos. 8 and 10 of the third segment also change the function to levators and to depressors of the abdomen. The origins of the muscles No. 8 in these formicids shift from the posttergum to pretergum of the third segment, thereby expanding in their size and increasing the power of the muscular contraction. Additionally, because the fourth segment pretergum of Myrmicinae and the ponerine tribe Ectatommini has a cuticular lobe which is attachment of the muscles No. 8 (Figs. 27 & 28), the