

A Challenge to the Subcoxal Theories of Pleural and Sternal Origins in Insects*

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The segment of insects is composed of the dorsal tergum, lateral pleuron and ventral sternum. Based on his embryological studies, Heymons (1899) suggested that the pleuron originates from the most proximal podomere or the subcoxa. His idea has been elaborated as the “subcoxal theory of pleural origin” by later morphologists such as Snodgrass, Weber and Matsuda. Ferris suggested the secondary nature of sterna, and Weber accepted this idea and developed the “subcoxal theory of sternal origin”. The subcoxal theories of pleural and sternal origin either have been widely accepted but variously discussed according to authors without really looking for reliable developmental facts in support (*cf.* Matsuda, 1970). In the present study, we critically examined the formations of pleura and sterna, using a cricket *Gryllus bimaculatus* as material, and discuss the origins of pleuron and sternum to review the subcoxal theories of pleuron and sternum.

A pair of ectodermal protuberances appears, and soon each of them differentiates into the proximal part or the tergum and the distal part or the thoracic appendage, which then divides into the coxopodite and telopodite by a deep demarcation. The terga develop and expand, and in the middle stage of development a curving shallow depression appears in the middle part of each tergum. Whereas the coxopodite divides into the proximal subcoxa and the distal coxa, the telopodite elongates and is segmented. In the anteroventral parts of the meso- and metathoracic terga, the spiracle invaginates. The spiracles have been usually regarded as pleural in origin (*cf.* Uchifune & Machida, 2005), but it may be more likely that the spiracles should be tergal derivatives in light of the serial homology between the spiracles and posterior tentorial pits formed in the gnathal tergal region.

Katatrepsis completes, and the terga rapidly extend dorsally. On the completion of dorsal closure, the larval cuticle is secreted. Simultaneously, the subcoxal region rapidly and substantially extends up to the definitive extension of pleuron. The pleuro-coxal joint invaginates near the subcoxa-coxal boundary, and from it the pleural suture differentiates and runs dorsally.

In the middle stage of development, most of cells have receded from the ventral area of each segment in association with the neurogenesis, and consequently the ventral surface of the segment is only covered with a thin cellular layer or a cellular sheath of developing ganglia. In the final stage of embryogenesis when the larval cuticle is secreted, the subcoxa starts to rapidly extend medially, and form the definitive ventral epidermis or the eusternum.

The present embryological, critical observations on crickets revealed that the pleura and sterna either are subcoxal derivatives. As for the sclerites containing spiracles, different from current understandings, their origin may be assigned to terga.

References

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