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Proceedings of the Symposium "Acquisition of Functional Diversity of Insects" (Ushiku-numa, July 10, 2021)

Preface

The prosperity of insects cannot be explained without adaptation from underwater to land, and even to the air. The acquisition of morphological and functional novelties significantly contributed to the diversification of insects. The dorsal appendage, the wing, is one of the most distinctive morphological novelties. Powered flight with the advent of wings allowed insects to explore new environments and expand their habitat. The origin of the wing has attracted the attention of scientists; however, the morphological structure from which the wing is derived remains controversial. Furthermore, it is also argued whether the molecular mechanisms that regulate wing development are conserved. Besides the wing, which emerged in the early stages of insect evolution, the exaggerated horns in scarab beetles, the enlarged mandibles in stag beetles, the gin-traps in darkling beetles, the eyespots in butterflies, the long eyestalks in stalk-eyed flies, and the helmets in treehoppers are morphological innovations in a specific insect group.

The symposium entitled "Acquisition of Functional Diversity of Insects" which was held online at the 57th Annual Meeting of the Arthropodan Embryological Society of Japan on July 10, 2021, focused on the morphological and functional novelties of arthropods, particularly the structures that emerged in the thorax. The symposium was originally scheduled for the 56th Annual Meeting, in 2020; however, it was canceled due to the COVID-19 pandemic. It was our great pleasure that the symposium took place with four leading scientists in this field.

Dr. Yoshinori Tomoyasu (Miami University, USA) gave a talk on genetic evidence supporting the dual origin hypothesis of insect wings (a combination of the tergal origin hypothesis and the pleural origin hypothesis) that allows us to reconstruct the evolutionary scenario for the emergence of insect wings. Dr. Takahiro Ohde (Kyoto University) covered the developmental origin of the hemimetabolous insect wings with a focus on the genes playing decisive roles in wing development, and discussed the evolutionary mechanisms of the insect wing. Dr. Yasuhiro Shiga (Tokyo University of Pharmacy and Life Sciences) described similarities in morphological characteristics and the gene regulatory mechanisms between insect wings and the crustacean carapace, the dorsal structure in the cephalothorax. Dr. Hiroki Gotoh (Shizuoka University) provided a topic on the precise developmental process of the helmet of treehoppers, a morphological novelty that appears in the pronotum (the dorsal thorax). The interpretation of the origin of the insect wing was extended to crustaceans, and the developmental characteristics of the novel structure, the helmet, were discussed.

Dr. Tomoyasu had a serious accident shortly after this symposium and is working hard on his rehabilitation. I pray for his recovery and hope he will soon return to his research.

Masatsugu HATAKEYAMA
Convener
Institute of Agrobiological Sciences,
National Agriculture and Food Research Organization,
Owashi, Tsukuba, Ibaraki 305–8634, Japan
sawfly@affrc.go.jp