

## LABORATORY OF MORPHODIVERSITY

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The aim of this laboratory is to observe the variety of the morphogenetic processes in the course of the ontogenesis of multicellular organisms and to analyze the mechanisms of such processes mainly by morphological methods. Accumulation of such analyses on the embryogenetic processes of related species is expected to give an insight into the evolution of morphogenetic processes. This laboratory uses the wings of lepidopteran insects for the material of morphological studies.

Wings of the lepidopteran insects (butterflies and moths) develop from the wing imaginal disc, which is a hollow sac made of simple epithelium. Due to its simple construction, this tissue is a good material to study cellular interactions in the course of morphogenesis.

The outline shape of the adult wing is often different from that of the pupal wing. This difference is brought about by the programmed cell death of the marginal area of the pupal wing. The marginal dying area is called "the degeneration region" and the internal area, which develops into the adult wing, is called "the differentiation region".

The cell deaths in the degeneration region proceeds very rapidly and completes in a half to one day period in *Pieris rapae* and several other species examined. It was shown that the dying cells in the degeneration region have characteristics common with the apoptotic cell death in mammalian cells, such as fragmented and condensed nuclei containing short DNA fragments detected by TUNEL staining. The cells in the degeneration region are actively engulfed by the macrophages in the cavity beneath the wing epithelium. The macrophages seem to be concentrated beneath the degeneration region by the strong adhesion between basal surfaces of the dorsal and ventral epithelium in the differentiation region, which occurs at the time of prominent cell death and excludes macrophages out of the differentiation region. Thus realized concentration of macrophages seems to accelerate the shrinkage of the degeneration region.

A collaborative work with the laboratory of Dr. K. Watanabe (Hiroshima University) is concerned mostly with the development of trachea and tracheole pattern in swallow tail butterflies. Trachea and tracheoles are both important in delivering air into the wing and their patterns coincide with that of the boundary of degeneration and differentiation zones at the distal end of the wing. According to the observations, the pattern formation of wing epithelium is often dependent on tracheal and tracheole patterns. Basic research on the development of tracheal pattern formation is being done by the scanning electron microscopy and the bright field light microscopy of the fixed or fresh specimens to describe the exact pathway and the time course of the formation of elaborate pattern of trachea and tracheoles and to establish the cytological and developmental relationship between the formation of tracheal pattern and epithelial cell pattern, such as scale cell pattern (Figure 1).

This laboratory also conducts morphological observation of several animal tissues by scanning and transmission electron microscopy and immuno-electron microscopic analyses. The training of specimen preparation and instrument operation for such observations is also given. These activities include the Division of Sex Differentiation and the Laboratory of Neurophysiology of our institute.

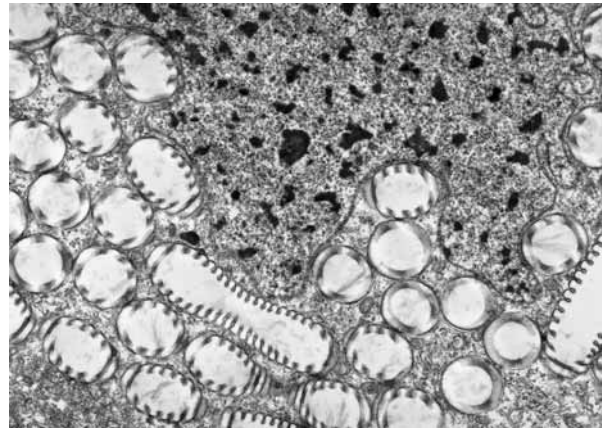


Figure 1. Transmission electron micrograph of the tracheole cell. Many cross-sections of the tracheoles can be observed within the cytoplasm of the tracheole cell. As the cell migrates, the tracheole is laid behind.

### Publication List:

#### Original paper

Watanabe, E., Hiyama, T.Y., Shimizu, H., Kodama, R., Hayashi, N., Miyata, S., Yanagawa, Y., Obata, K., and Noda, M. (2005). Sodium-level-sensitive sodium channel Nax is expressed in glial laminate processes in the sensory circumventricular organs. *Am. J. Physiol.*, in press.