Histological Analysis of the Dynamics of Growth of Imaginal Discs and Histoblast Nests During the Larval Development of *Drosophila melanogaster* *

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**Summary.** 1. Histological analyses were made of imaginal discs and histoblasts during the larval development of *Drosophila melanogaster* to determine the number of cells, the patterns of cell division and the growth dynamics in these adult primordia. Histological studies were also made of the imaginal rings which are the primordia of the adult salivary gland, fore- and hindgut, the anlage cells of the midgut and several larval and embryonic tissues.

2. In the newly-hatched larva, the immature eye-antenna, wing, haltere, leg and genital discs contain about 70, 38, 20, 36-45 and 64 cells respectively. These numbers include cells destined to form cuticular elements as well as peripodial, tracheal and nerve cells and probably the progenitors of adeptelial cells. The number of cells counted in the various imaginal disc anlagen is 1.5 to 4 times higher than the numbers deduced from genetic mosaic analyses by other investigators and reasons for these differences are given.

3. About 12 h after fertilization, mitosis ceases in all tissues of the embryo except the nervous system. After the larva hatches, mitosis resumes in most of the imaginal anlagen and in some larval tissues. The time of resumption of mitosis in the imaginal anlagen was determined after treating the larvae with colchicine for 2 h.

4. Among the imaginal discs, the eye disc is the first to begin cell division, at about 13-15 h after the hatching of the larva (first instar) followed by the wing (15-17 h), the haltere (18-20 h), the antenna, leg, and genitalia (24-26 h, early second instar), and finally the labial and dorsal prothoracic

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* We dedicate this paper to the memory of our dear colleague Dr. Elizabeth B. Fosket (1941-1973) who was involved in early phases of this research and was deeply interested in the problems we have analysed

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discs (52–54 h, early third instar). The cell doubling time for various discs was calculated from cell counts and the times agree closely with the doubling times deduced from clonal analyses by other workers: e.g., 7.5 h for the cells of the wing disc.

5. The imaginal ring of the hindgut first shows cell division early in the second instar. The imaginal rings of the foregut and salivary glands, the anlage cells of the midgut and the cells of the segmental lateral tracheal branches begin to divide early in the third instar.

6. The histoblasts which are the anlagen of the integument of the adult abdomen do not increase in number from the time of larval hatching until about 5 h after pupation when they begin to divide. Their behaviour contrasts with that of the histoblasts of the other dipterans such as Calliphora, Musca and Dacus, which begin to divide during the second instar.

7. The histoblasts are an integral part of the larval abdominal epidermis and, unlike imaginal disc cells, secrete cuticle during larval life. Each hemisegment consists of an anterior dorsal, a posterior dorsal, and a ventral histoblast nest containing about 13, 6 and 12 cells respectively. The 62 histoblasts in each larval segment represent about 7–8% of the total number of cells that form the integument of that segment.

8. The number of cells in a particular type of histoblast nest was constant for both male and female larvae and among the different abdominal segments, except that the anterior dorsal group of the first and the seventh segments contains fewer cells than those of the other segments. Although the male and female adult Drosophila lack the first abdominal sternite and the male lacks the seventh abdominal tergite and sternite, the ventral histoblast nests of the first and the dorsal and ventral nests of the seventh abdominal segments are present in the larval stages as well as in the prepupa and have the same morphology and cell number as similar nests in the rest of the abdominal segments.

9. The cells of the imaginal discs increase in volume about six-fold and their nuclei increase in volume three-fold between the time of hatching and the initiation of mitosis. The histoblasts increase in volume about 60-fold and their nuclei increase in volume about 25-fold between larval hatching and pupariation.

10. Prior to each cell division, the nuclei of the columnar cells of the disc epithelium and of the histoblasts appear to migrate toward the apical surface of the epithelium. The cells round up and shift toward the apical region where mitosis occurs. After cytokinesis, the daughter cells move back to deeper positions in the epithelium. Because the nuclei of the non-dividing cells continue to lie deep in the epithelium, this intermitotic migration of nuclei gives these epithelia a pseudostratified appearance.

11. Analyses of the growth of larval cells and of organs confirmed the observations of earlier investigators that cell division occurs only in a few larval tissues, whereas growth in the rest of the larval tissues is by cell enlargement and polyteny. During larval life, cell division was detected only in the central nervous system, gonads, prothoracic glands, lymph glands and haemocytes. Each tissue began mitosis at a characteristic stage in larval