Histological Observations of the Ovary
in the Fifth Instar Larva of Triploid
Silkworm, *Bombyx mori* L.
(Lepidoptera : Bombycidae)^{1,2}

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In the silkworm, the oogenesis of polyploids were reported by HASIMOTO (1934), KAWAGUCHI (1936), OOI (1962) and TAMAZAWA (1977), and further the fertility of polyploids were discussed by these investigators. SUGAI and SUGITA (1976) stated that triploid females were crossed with diploid males and approximately 70% of the oviposited eggs became pigmented but failed to develop any further. Regarding this failure in development, in the present report the authors made histological observations of the ovary of the 5th instar larvae in triploid to determine in part, the cause of induction of the imperfect development of the oviposited eggs.

The strains of the silkworm, used in the present study were re9 (a red egg strain; $+ch/+ch \cdot ps/ps \cdot re/re \cdot +W_2/+W_2$) and TW1 (a white egg strain; $ch/ch \cdot P/P \cdot +re/+re \cdot W_2/W_2$). F_1 eggs of the cross $re9 \times TW1$ showed normal color (black). Egg-color segregation of F_2 was black:red:white = 9:3:4, and that in the back cross with TW1 was black:white = 1:1. The tetraploid silkworm were induced by the method of TAMAZAWA and TAKIZAWA (1977). In other words, re9 females were crossed with TW1 males and the eggs at 120 to 150 minutes after deposition were treated at -10°C for 24 hr and returned to 25°C . Tetraploid eggs were obtained by selecting eggs with enlarged serosa cells. Tetraploidy of females was confirmed by the deposition of eggs of large

size and by egg-color segregation in the back cross with TW1 (black:white = 5:1). As reported by KAWAGUCHI (1936), tetraploid males showed quite a low fertility. The female larvae which were obtained from the cross $re9 \text{♀} \times TW1 \text{♂}$ and $4n \text{♀} \times TW1 \text{♂}$ were used for the materials of $2n$ and $3n$, respectively. In each material of $2n$ and $3n$ larvae, the ovary was respectively excised at 24 hr intervals from the 1st to the 6th day (full grown larvae) of the 5th instar. They were fixed with Bouin's solution, sectioned in $5 \mu\text{m}$ thickness and stained with Delafield's haematoxylin and eosin. The results of the present study were obtained from the observations of five ovaries in each sampling.

In $2n$ larvae, the ovarioles became elongated and curved within the ovary during the period from the 1st to the 6th day of the 5th instar (Fig. 1A). During this period ovarioles could be divided into 3 zones as reported by MIYA et al. (1970). The proximal end of the ovarioles was Zone I where many oogonia and one apical cell existed. Zone I was connected with Zone II, in which cells in the early oogenesis were seen. In the lower part of Zone II, oocyte-nurse cell complexes were not yet arranged regularly but were seen intermingled with each other with follicle cells intervening among them. However, oocyte and nurse cell were distinguishable morphologically. Zone II was connected with Zone III, which occupied two-thirds of the entire length of the ovariole. In Zone III, oocyte-nurse cell complexes were enclosed by the follicle cells and were arranged regularly in a typical polytrophic disposition. Degenerated germ cells in the ovarioles were seen during the period of the 5th instar. Namely, in Zone I, only a few degenerated oogonia were seen during the period of the 5th instar. In Zone II, only a few degenerated cells were seen on the 1st day but after the 2nd day a few were found. In Zone III, oocyte-nurse cell complexes were normal during the period of the 5th instar. The degeneration of germ cells may be caused merely by a deficiency of nutrition of oogonia which were formed in the later stages in the oogonia.

In $3n$ larvae, the development of the ovarioles on the 1st day of the 5th instar was remarkably

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Fig. 1. Ovary on the 6th day of the 5th instar larva. A: 2n. $\times 25$. B: 3n. $\times 25$. C: 3n. The lower end of the ovariole. $\times 60$. ZII, Zone II in which oocyte and nurse cell were seen intermingled with each other. ZIII, Zone III in which oocyte-nurse cell complexes were seen only 1.

Fig. 2. The degenerated cells in the ovariole of the 5th instar in 3n larva. $\times 260$. A: Zone I of the 1st day larva. B: Zone I of the 6th day larva. C: Zone II of the 6th day larva. d, degenerated cell.

inferior to 2n larvae and even on the 6th day, the ovarioles were only slightly elongated (Fig. 1B). During the period from the 1st to 3rd day the ovarioles could not be divided into separate zones and were occupied only by oogonia. When the 4-5th day was reached the ovarioles could be divided into 3 zones as described above in some of the individuals but the space which was occupied by Zone II and III was markedly narrow as compared with that of Zone I. Therefore, the number of cells in Zone II and III was smaller than that of Zone I. Especially, the number of

oocyte-nurse cell complexes in Zone III was found to be only 1 to 3 (Fig. 1C). On the 6th day, the ovarioles could be divided into 3 zones in all individuals but the space of each zone was seen to have spread slightly. In the process of oogenesis during the period of the 5th instar many degenerated oogonia were observed in Zone I (Fig. 2A and 2B) although only a few degenerated oogonia were observed in diploid larvae, as was stated previously. Further, some degenerated cells were seen in Zone II (Fig. 2C) but the degeneration of oocyte-nurse cell complexes

in Zone III was not clear. KAWAGUCHI (1938) also observed the degenerated oogonia in 3n larvae. Therefore, the inferiority of oogenesis in 3n larvae may be caused by the degeneration of oogonia.

HASIMOTO (1934) and KAWAGUCHI (1936) stated that the triploid females oviposited eggs irregular in shape or included large and small ones, while OOI (1962) reported that the triploid females from lethal spindle-shaped eggs, lay eggs which were uniform in size. Although these phenomena may be caused by the difference in strain, further investigations are necessary. As 3n larvae develop normally, the somatic division may be considered to be also normal. Accordingly, all cells in the various organs and systems of 3n larvae have an identical combination of chromosomes, and various germ cells in the ovarioles from the stage of oogonium should be identical. It is not clear why such a remarkable degeneration of germ cells occurred especially in the oogonia in 3n larvae. The histological observations in this study were limited to the 5th instar larva

and it is necessary to conduct a more detailed observation of oogenesis from the young larva to the adult.

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Occurrence and Fecundity of Two Color Forms in *Aphis gossypii* GLOVER (Homoptera : Aphididae) on Dasheen Leaves¹

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Color variation ranging from light yellow to dark green in *Aphis gossypii* GLOVER has been repeatedly observed. WALL (1933) classified the body color into ten categories and reported minutely on the heredity of those color forms, and also related them to body size. The differences in color according to the host plant were observed carefully by INAZUMI (1968, 1970). Furthermore, some other scattered reports on the variability of color in this aphid are found.

Aphis gossypii GLOVER is an important insect

pest of dasheen, *Colocasia antiquorum* in southern Kyushu and in the apterous viviparae, three main color forms, greenish, yellowish and intermediate, are usually found during the growing period of the crop in the field.

In this paper the differences in population growth and reproductive rate of apterae between two striking color forms on dasheen were compared under different temperatures.

The population density of the aphid in dasheen fields increased towards summer and decreased in early autumn.

The yellowish form exceeded 60% at the peak period in June and July, but it was under 50% before June and after mid-August (Fig. 1).

When two each apterae of both color forms were liberated together and allowed to reproduce on a potted dasheen plant, yellowish individuals became more abundant under a high temperature of 27°C, but under 20°C the proportion of the two color forms was almost the same (Fig. 2).

Most of the offspring of greenish individuals

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