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ULTRASTRUCTURAL ASPECTS OF THE SEX-DIFFERENTIATION OF GERM CELLS IN THE TELEOST, *ORYZIAS LATIPES*

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It has been reported that the sex-differentiation of germ cells in *Oryzias latipes* can be morphologically observed after the completion of the migration to the gonadal anlage (Satoh and Egami, 1972 : Hamaguchi, in press). There are no differences between the numbers of primordial germ cells (PGCs), which come to the gonadal anlage (Quirk and Hamilton, 1973). Thereafter, PGCs in the female divide at higher rate than those in the male, and the number of germ cells in the fry immediately after the hatching is twice as large as that in the male (Hamaguchi, in press). After hatching, the female germ cells continue to proliferate and some of them proceed into the meiotic prophase. On the contrary, the male germ cells enter into a mitotically dormant period, and it is not until 15th day after hatching that they regain their mitotic activity (Satoh and Egami, 1972 ; Hamaguchi, 1979). From the point of view of the proliferative activity and initiation of meiosis, the differentiation of germ cells in the female is more rapid than that in the male.

From ultrastructural observations of germ cell lines of *Xenopus laevis*, Kalt (1973) pointed out the similarity between primordial germ cells, oogonia and spermatogonia. Similar results were reported by Satoh (1974) on germ cells in the embryos and fry of *Oryzias latipes*. In the present study, the author directed his attention to the morphology of the germinal dense bodies as an indication of the cytodifferentiation of germ cells. Germinal dense bodies are known to exist in germ cells in various species of animals (Eddy, 1975), and are considered to be a cytoplasmic marker specific to germ cells. In *Oryzias latipes*, Yamamoto (1964) first reported the existence of an "electron-opaque substance" in young oocytes, and Satoh (1974) observed similar structures in PGCs, oogonia, oocytes and spermatogonia in embryos and fry. Ultrastructural observations of the PGCs during

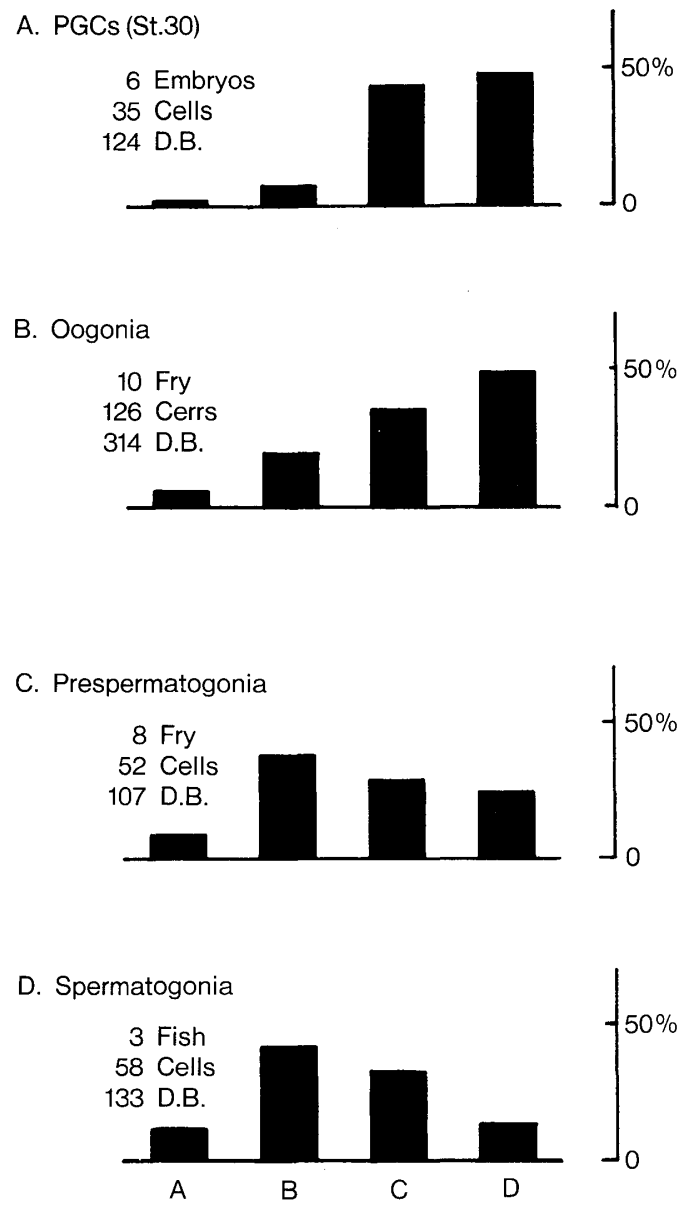

Fig. 1. The morphology of GDBs in germ cells at various stages of development. According to the classification of the morphology in the GDBs shown in the text, percentages of each types are shown.

their migration to the gonadal anlage revealed that the mophology of the germinal dense bodies (GDBs) changed according to the stages of translocation (Hamaguchi, unpublished). In PGCs of the endodermal layer, the GDBs have a strand-like structure whose thickness is about 300A. Thereafter, PGCs are transferred to the dorsal mesentery through the somatic mesodermal layer of the lateral plate, when GDBs are changed into amorphous masses of electron-dense fine fibrils. This alteration in the morphology of GDBs occurs gradually, and structure intermediate between strands and amorphous masses can be seen. The morphology of GDBs can be classified into the following four types of structure: (1) strand-like structures, (2) a small patch of amorphous masses of fine fibrils in the strand-like portion, (3) mostly composed of amorphous masses, but with strand-like structures in the peripheral regions, and (4) amorphous masses of electron-dense fine fibrils. According to this classification, the morphology of GDBs in germ cells of embryos at stage 30, when the migration of germ cells has just been completed, can be described as shown in the Fig. 1A. Using this classification, the morphology of GDBs in germ cells during later stages of development was analysed, and the cyto-differentiation of germ cells during the sex-differentiation of gonad was examined.

In the gonads of the female fry, oogonia and oocytes at various stages of meiotic prophase can be seen. The morphological changes in GDBs abvanced in the direction from type A to D, according to the progress of the stages in meiosis. In the diplotene oocyte, more than 60% of GDBs were type D. The morphology of GDBs in oogonia resembled that in PGCs at stage 30 (Fig. 1B).

In the male, spermatogenesis does not begin before 60 days after hatching, and all germ cells in the fry are at the "prespermatogonial" stage. Though the proliferative activity of prespermatogonia changed according to the development of the fry, no changes were found in the morphology of the GDBs in prespermatogonia. Fig. 1C shows the morphology of GDBs in prespermatogonia. It is obvious that strand-like structures are more dominant in the prespermatogonia than in PGCs at stage 30 or oogonia. Studies on the morphology of GDBs in spermatogonia of the adult fish revealed that the morphological features of GDBs in prespermatogonia were unchanged in the spermatogonia (Fig. 1D). This indicates that the dominance of strand-like structures in the prespermatogonia cannot be attributed to the retardation of the initiation of meiosis in the male fry. In other words, the difference in the morphology of GDBs shown in the present study can be interpreted as an ultrastructural feature of sex-differentiation of germ cells.

The present observations lead to a number of questions. Can this sex-difference in the ultrastructure be observed in PGCs at earlier stages? What is the physiological meaning of the morphological changes in GDBs? What kind of relationships are there between GDBs and the differentiation of germ cells? These questions await further investigations.

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