Polyploidy in the Japanese newt, *Triturus pyrrhogaster*

Tosiziro KAWAMURA

Zoological Laboratory, Hirosima University, Hirosima

FANKHAUSER and GRIFFITHS ('39)[1] obtained many haploid and triploid larvae of *Triturus viridescens* by refrigeration of freshly laid eggs. The triploid larvae were all normal and the majority of them developed normally to metamorphosis. The haploid ones were characterized by small size and varying degrees of edema. GRIFFITHS ('40, '41)[2][3] ascertained that all triploids developed from eggs that had been refrigerated immediately after laying. KAYLOR ('40)[4] discovered two triploids among androgenetic larvae of *Triturus pyrrhogaster*.

I made an experiment upon the production of polyploidy in the Japanese newt, *Triturus pyrrhogaster*, by cold treatment of fertilized eggs after FANKHAUSER and GRIFFITHS' method. A part of the results obtained during the season of the year 1940 will be presented here preliminarily.

Many uterine eggs were taken out from females in which two or three pituitary bodies had been implanted two days before. Ten to ninety minutes after artificial fertilization, they were exposed to 0° to 0.5°C for 18 to 27 hours and then reared under room temperature. Chromosome counts were made in early larval stage by FANKHAUSER's tail-tip method.[5] The amputated tail-tips were preserved in NAVASHIN's fluid and stained with HEIDENHAIN's iron hematoxylin.

According to the chromosome numbers, the larvae which developed from refrigerated eggs could be divided into the following five types: diploid, triploid, haploid, haploid-diploid, and haploid-triploid. The number of larvae of each type is presented in Table 1. Thirty larvae from untreated eggs were without exception diploid. As in *Triturus viridescens*, there were produced many triploid larvae which were normal in appearance. Some of them were fixed in the larval stage for examining the structures of the internal organs, and most of the others could be raised, passing through

1) FANKHAUSER, G. and R. B. GRIFFITHS: Proc. Nat. Acad. Sci., **25**, 233–238 (1939).
2) GRIFFITHS, R. B.: Anat. Rec., **76**, Suppl., 26–27 (1940).
3) ——————: Genetics, **26**, 69–88 (1941).
4) KAYLOR, C. T.: Biol. Bull., **79**, 397–408 (1940).
5) FANKHAUSER, G.: Proc. Amer. Philosoph. Soc., **79**, 715–739 (1938).

Zool. Mag. (Tokyo), Vol. 53, No. 11, 1941.

metamorphosis. The three haploid larvae showed poor development and could not reach the time of metamorphosis. Two of them were found dead and the other was preserved, because it was an extreme dwarf. In the haploid-diploid individuals, diploid areas were comparatively extensive. One larva died before the time of metamorphosis and another was fixed immediately before the perfect absorption of the gills, since it had developed a severe edema. The remaining one could complete metamorphosis and became a dwarf newt.

Table 1. Number of larvae of each type produced by cold treatment of fertilized eggs.

Experiment No.	Hours till treatment after fertilization	Hours of treatment	Number of larvae	Diploid	Triploid	Haploid	Haploid-diploid	Haploid-triploid
I	About 1	24	1	1				
II	1/2–3/4	20	11	5	5		1	
III	1/6–2/3	18	22	5	16	1		
VI	1/2–3/4	18–19	63	16	41		1	5
VII	〃	26	56	11	40	2		3
VIII	〃	19	5	1	4			
IX	1/2	24	5	2	3			
XI	1/3	23	1		1			
XII	1/2	24	9	3	6			
XIII	3/4	〃	2		2			
XIV	1	〃	2	1	1			
XVII	2/3	22	1	1				
XVIII	1	24	3	1	2			
XIX	11/2	21	8	6	1		1	
XX	1	27	1	1				
			190	54	122	3	3	8

The most interesting individuals are the haploid-triploid ones. This kind of mosaic has been known only among parthenogenetic frog tadpoles produced by me ('39).[6] Of the eight haploid-triploid larvae of *Triturus pyrrhogaster*, four died before the time of metamorphosis and the other four could be metamorphosed completely. Two of the latter were fairly large and the others smaller, but they were all within the range of length of normal diploid newts in the same stage. In two of these metamorphosed newts the right halves of the bodies, roughly speaking, consisted of triploid cells and the left halves of haploid cells. Such distribution of haploid and triploid cells was most distinctly seen in the spinal cord, chorda dorsalis and kidneys. In the third newt, both areas were not so clearly divided, though the left half was mostly triploid and the right was a mixture of haploid and triploid cells. The fourth newt consisted mostly of triploid cells and some haploid cells were mingled in the triploid. The origin of the haploid-triploid condition in the former two newts at least seems to be as follows: the male pronucleus may not be united with the female one before the first cleavage and may be divided into two daughter nuclei. The chromosomes of the female pronucleus may be doubled by monaster division or some other ways nearly at the same time as the male one is. The first division of the cytoplasm may be led by the male pronucleus and the derivative of the female one may be contained in one of the blastomeres. Accordingly, the haploid-triploid condition may be established at the two-cell stage. Whether this explanation applies in the other two newts or not, will be considered after the distribution of both kinds of cells in the whole body have been observed in detail.

The structures of the gonads and other organs in such mosaics, as haploid-diploid and haploid-triploid individuals, are now under investigation.

The present study was aided by a grant from the Imperial Academy, for which I wish to express gratefully my indebtedness. My thanks are also due to Profs. Y.K. HIRAIWA and T. KOMAI for their continued interest and invaluable criticism.

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6) KAWAMURA, T.: Jour. Sci. Hirosima Univ., Ser. B, Div. I, **6**, 115–218 (1939).