The Inert Chromosomes of *Drosophila ananassae* Doleschall

By

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In the oogonial metaphase of *Drosophila ananassae* synonymous to *D. caribbea* of STURTEVANT, as shown in my previous paper (KIKKAWA 1936), four pairs of chromosome association are formed, consisting of three larger and one smaller, all being in V-shape. In the spermatogonial metaphase, one of large V-shaped chromosomes is replaced with a small J-shaped one. Therefore, this association can be regarded as representing sex-chromosomes, i.e., X and Y.

Judging from the type of chromosome association above mentioned, this species should have four large linkage groups. But, so far only three of them have been found: X = 28 (including multiple alleles), II = 19, III = 12. This fact suggests strongly that one of autosomal pairs is inert. My recent cytological observations have proved the fact clearly.

Fig. 1. a. Oogonial metaphase of haplo-IV female. b. Female salivary gland chromosomes.

Fig. 2. Mosaic female. Left: Diplo-IV. Right: Haplo-IV.

In the nucleus of a salivary gland cell, there are found eight strands of chromosomes, of which two are very small and embedded in the chromocenter (Fig. 1, b). As PAINTER and STONE (1935) have mentioned, two strands of a V-shaped chromosome are generally connected at the locus of spindle-fiber attachment, even when they are dissociated under pressure from the chromocenter. From these cytological findings, the small strands within the chromocenter represent one pair of chromosomes. Since PAINTER and others pointed out that the inert or the inert region of chromosome is scarcely visible in the salivary gland cell, the pair of chromosome in question is assumed as representing it. Furthermore, there is an evidence that the pair belongs to one of autosomes; the X-chromosomes in the male are easily distinguished from the autosomes in a salivary gland cell.

But, it still remains us to be replied which pair of autosomes is inert. In order to give a proper answer to this question, several attempts have been performed till we at last come to find out flies which correspond to haplo-IV or Diminished of *D. melanogaster* (Fig. 2). Cytological examination of them has disclosed that one of small V-shaped chromosomes (the fourth chromosome) is missing (Fig. 1, a). Hence, there is almost no doubt that the small V-shaped chromosomes are virtually inert.

In connection with this conclusion, it may be supposed that the distal part of one arm of this inert chromosome is homologous to the short arm of the Y-chromosome. Evidences for this hypothesis are given in the following experiments: (1) If haplo-IV males are mated to normal females, the number of haplo-IV males which appear

in the offspring, is greater than that of haplo-IV females whereas the number of normal males is only about a half of the corresponding females (Table 1).

Table 1. $+ \varphi \times \text{Haplo-IV } \sigma$

Normals		Haplo-IV		Total
$\varphi \varphi$	$\sigma \sigma$	$\varphi \varphi$	$\sigma \sigma$	
867	381	228	487	1963

This unexpected result may, however, be easily accounted for by the assumption that the Y-chromosome occasionally synapses with the free fourth chromosome. The schema illustrating this relation is given in Figure 3.

The frequencies of appearance of the offspring which results from the combination of one of these sperms with a normal egg are:

Normal females,	$(2x + y)/4$
Normal males,	$y/4$
Haplo-IV females,	$y/4$
Haplo-IV males,	$(2x + y)/4$

Fig. 3. Figure illustrating the relation between sex and fourth chromosomes.

The values x and y calculated from the experimental results are: $x = \text{ca. } 38\%$, $y = \text{ca. } 62\%$ respectively. The discrepancy found between theoretical and experimental results is apparently due to low viability of haplo-IV individuals.

(2) If XXY females are mated to normal males, there appear in the offspring many haplo-IV individuals (Table 2).

This unexpected result is also accounted for by the assumption that the free Y-chromosome in XXY female often synapses with one of

the fourth chromosomes. In facts, the Y-chromosome generally comes near the fourth chromosome in the oogonial metaphase of XXY or of XXY haplo-IV female, and even in the spermatogonial metaphase of normal male. These cytological studies suggest that the short arm of the Y-chromosome is homologous to the distal part of an arm of the fourth chromosome.

Recently, KAUFMANN (1936) observed an interesting phenomenon concerning this problem. According to him, the small autosomes are attached to the nucleolus during early prophase of the division of ganglion cells, and in the male the Y-chromosome forms the

Table 2. XXY ♀ × XY ♂

Normals		Haplo-IV		Total
♀ ♀	♂ ♂	♀ ♀	♂ ♂	
585	522	147	123	1377

third member of such a group. This fact further adds an evidence from the cytological view-point.

Further details on this problem are preserved for a future occasion. At present, the indication of the presence of an inert chromosome like Y-chromosome or androsomes of *Sciara* in *Drosophila* as well as that of the existence of homologous parts between sex and somatic chromosomes, promise a profitable development as to the relation between genes and chromosomes.

In conclusion, I wish to express my hearty thanks to Professor TAKU KOMAI for his valuable advice and criticism, and also to Hattori Hôkôkwai for its financial aid.

Literature cited

- Kaufmann, B. P., 1936. The chromosomes of *Drosophila ananassae*. Science 83: 39.
Kikkawa, H., 1936. Chromosomes of *Drosophila ananassae* (a preliminary note).
Jap. Journ. Genet. 12: 65-66.
Painter, T. S., and W. Stone, 1935. Chromosome fusion and speciation in *Drosophila*.
Genetics 20: 327-341.
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