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A theoretical and experimental study on the changes in the crossing-over value, their causes and meaning

Eloff, Gerhardus

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Summary

Part I

A study of the literature was made as to the changes in the crossing-over value and it was found that these may be brought about by physical agencies e.g. temperature X-rays and radium; by physiological agencies e.g. age and sex; by genetical causes e.g. crossover modifiers. Crossing-over was studied in cases of non-disjunction and polyploidy, of translocation, deletion and deficiency. In certain cases in fish the frequency of crossing-over from X to Y was compared with that from Y to X. The outcome of these studies may be briefly summarised.

1. Inter- and intra-chromosomal differences in reaction to the same physical agent was found. The central regions of the 2nd and the 3rd chromosome and the right end portion of the 1st chromosome of *Drosophila melanogaster* were found to be more liable to changes in the c.o.v. than other regions. These sensitive regions correspond with the place of attachment of the spindle-fibre.

2. Studies in cases of non-disjunction and polyploidy showed that the Y-chromosome had no effect on crossing-over in XXY females; crossing-over may take place between three homologues of a triploid female.

3. Very important were the results obtained in connection with translocation, deletion, inversion and deficiency. These studies suggest a new line of action, which, with due attention to the foresaid factors, makes it possible to construct chromosome maps which are more in agreement with the actual chromosome as has been hitherto the case. Translocations have the advantage that they may be evoked experimentally by X-rays.

Part II

Experiments were done with *Lebistes reticulatus* in order to obtain data which will make it possible to compare the crossing-over value when crossing-over takes place from X to Y with that obtained when crossing-over takes place from Y to X. The problem at issue is that

the difference in frequency between the two directions of crossing-over suggest an exchange adaptation in so far as the recipient chromosome has to adapt itself to the donor chromosome. The results were briefly as follows.

1. Crossing-over of the elongatus (El) factor from Y to X takes place in 1.8 percent of the cases.

2. Results obtained from the cross $X_oX_o \times X_{El}Y_{Ma}$ in order to determine the frequency of crossing-over of El from X to Y were quite contrary to expectation, for, with the exception of 3 males with a round caudal fin, all others had an elongated caudal fin. This suggests that the parent male was not of the constitution $X_{El}Y_{Ma}$, neither could it have been of the constitution $X_{El}Y_{Ma,El}$, so that this remains to be made out by suitable experiments. So far crossing-over from X to Y takes place in $\pm$ 1.4 percent of the cases according to WINGE.

3. The factor for maculatus which has hitherto been looked upon as sex-limited, has been found to cross over from Y to X.

4. The expression of the El factor was studied in connection with the development of the colour pattern of the male *Lebistes*. It was found to express itself relatively later than most of the main colour patterns.

5. Technical suggestions were made.

Experiments were also done with *Drosophila melanogaster* and the effects of centrifugation and of treatment with ultra violet light were studied on crossing-over between black and vestigial in the second chromosome. Special study was made of the difference in crossing-over between repulsion and coupling back-crosses. The results were as follows.

1. Centrifugation caused an increase in the crossing-over value for the repulsion as well as for the coupling back-crosses.

2. Treatment with ultra violet light caused an increase in the crossing-over value for repulsion but a slight decrease for the coupling back-crosses.

3. The crossing-over value for repulsion back-crosses for all experiments was much higher than that for coupling back-crosses, the totals were very reliable and the difference between the crossing-over value for repulsion and the crossing-over value for coupling was found

to be 11 × m diff. A brief survey of cases discussed in part 1 together with own data show that the difference was always in favour of the repulsion back-crosses. It is suggested that the difference is roughly proportional to the difference between the number of mutant factors concerned in the homologues. It is further suggested that the difference is not due to the differences in the viability of the classes, but to the relatively greater asymetry between the homologues in the case of a coupling back-cross.