

genetically inert parts of the *X*-chromosomes could influence only the disjunction of the *CIB* chromosome and the right (non-translocated) part of the other *X*-chromosome, as the left part, translocated to chromosome 4, does not carry any of the inert region of the *X*-chromosome. Non-disjunction of the left part of this *X*-chromosome and the *CIB* chromosome is much lower than would be expected if Darlington's hypothesis applies to *Drosophila*, and seems therefore to show that regular disjunction of chromosomes is not absolutely conditioned by crossing-over.

It seems clear that both crossing-over and chromosome disjunction are dependent on a third, more general factor, possibly on the intensity with which the conjugation of chromosomes takes place.

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DOBZHANSKY¹, Gershenson (above) and others have concluded that the disjunction of chromosomes does not depend directly on the occurrence of crossing-over between them, as I assume to be the case in all homozygous organisms². They maintain that some "other factor" is concerned in their experiments. But these experiments have necessarily made use of hybridity, without which genetical tests are impossible; and the particular kind of hybridity (structural hybridity) they have used is bound to have a complicated effect on disjunction. It is itself the "other factor". Thus reciprocal crossing-over within two relatively inverted segments should give normal chromosomes with normal disjunction, other things being equal.

But when we consider the structure of the bivalent given by such crossing-over, we see that the disjunction expected in straightforward bivalents will not necessarily follow (Fig. 1). The pull which is to separate the paired chromatids is parallel to the plane of their association and not perpendicular to it. Resistance to separation is therefore not a certain constant minimum, but a function of the length between the two chiasmata. I have observed failure of disjunction in these circumstances in an inversion heterozygote in *Stenobothrus parallelus*. Other kinds of crossing-over in dislocated segments give rise to lagging, interlocking and irregular breakage. It is not therefore surprising that Grüneberg³ finds the 'non-disjunction' that has previously been attributed to non-pairing and random segregation is often due to loss of both partners.

This is merely one example of the special complications arising in structural hybrids. They have been described by Richardson for inversion hybrids and by myself for interchange hybrids in articles in the press⁴. They show the danger of arguing from the assumptions involved in an abstracted formal use of the terms "chromosome", "non-disjunction" and even "crossing-over" by the geneticist. They also show the difficulty the geneticist is faced with

in dealing with the highly selected viable progeny of structural hybrids, a difficulty which can only be overcome by a close collaboration between those who are breeding the hybrids and those who are studying the structures found at meiosis in comparable material².

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¹ *Z.I.A.V.*, **64**, 269-309.

² *J. Genet.*, **31**, 185-212.

³ *J. Genet.*, **31**, 163-184.

⁴ *J. Genet.*, in the press.

Induction of the Eye by a Specific Substance in the Amphibia

IT is known that in the axial mesoderm of the Amphibia, the capacity to induce individual organs varies from anterior to posterior, each organ having its 'induction field'¹. After the discovery of inducing substances it is natural to consider whether the existence of these fields may be explained by the localised distribution of specific substances which determine their properties.

If this suggestion were found to be true in the case of any one organ, one could generalise and assume that it is true for other organs as well. The following investigation deals with the eye; if the development of this organ is determined by the presence of a specific substance, the diffusion of this substance from a dead eye must induce, in the ectoderm of an early gastrula, only eyes or eyes with the adjacent region of brain. Accordingly, optic vesicles were removed from *Axolotl* or *Triton taeniatus* in the tail-bud stage, killed by treatment with boiling water or alcohol, and implanted in the blastocoels of early gastrulae of *T. taeniatus* or enveloped in flaps of presumptive ectoderm of that species. Eyes were induced in 100 per cent of the positive cases, either in whole embryos or in explants. In whole embryos induction was found to be independent of the level of the host. They were usually connected with a mass of brain tissue, which might be smaller than the eye; in some cases, several eyes were formed together. The eyes were normally shaped; and the retinal part of the eye was capable of inducing a lens from the host ectoderm, if it came in contact with it.

The conclusions which may be drawn from these facts are as follows: (1) The agent which induces the primary embryonic axis is not unspecific as regards the region of axis which is induced; possibly it includes a mixture of specific substances or entirely consists of such specific substances. (2) The regional differences within the primary embryonic axis are determined by the corresponding distribution of specific formative substances. (3) Polarity in the system of ectomesoderm² is possibly determined by a similar distribution of substances from pole to pole. The phenomenon of regulation must be accounted for by the assumption that these substances follow the principle of polar distribution, and that after a disturbance of the system the previous distribution of the substances is restored.

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¹ Holtfreter, *Joh. Arch. Entw.-mech.*, **127**; 1933.

² Lopashov, G., *Biol. Zentrbl.* (in press).

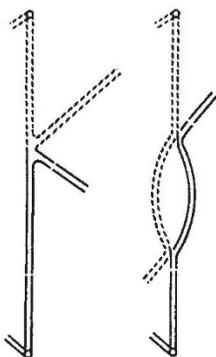


FIG. 1. The structure of bivalents with single (left) and double reciprocal crossing-over (right) between relatively inverted segments of homologous chromosomes.