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TOUCH-AND-GO PAIRING IN CHROMOSOMES

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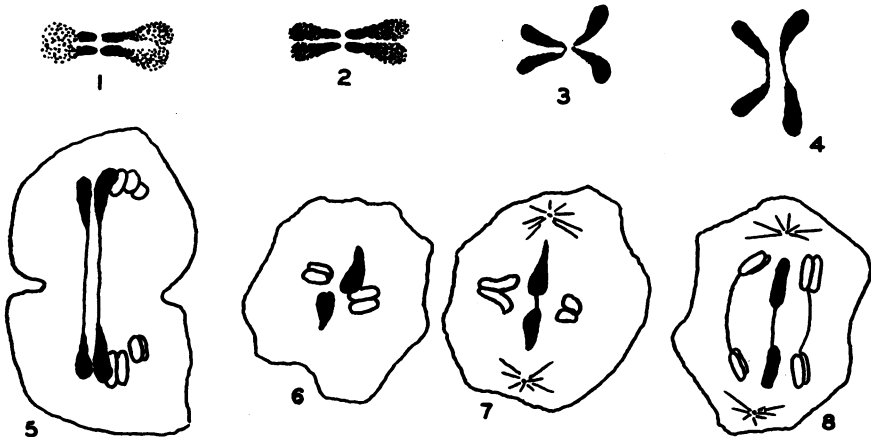
An orientation of chromosomes that appears to be independent of meiotic synapsis in the ordinary sense is shown in a relatively large number of species. Usually this takes the form of a vis-à-vis position on the spindle and when such chromosomes are separated by a considerable distance is called "distance conjugation" (Lorbeer, '34).¹ In other cases the involved chromosomes may actually come together for a period which in some instances is so brief that the movement has received the name "touch-and-go" process (Wilson, '25).²

The mechanism involved is a very puzzling one. In a general way the explanations that have been offered fall under two headings: (a) that some kind of attraction between the chromosomes is involved (Wilson, '32)³ or (b) that it is mitotic forces ("centromere-spindle relationship") that bring about this orientation and that no specific attraction is involved (Darlington, '39).⁴

This latter explanation fails to account for the fact that in some instances such chromosomes approach each other before the spindle has been fully formed. Thus the *m* chromosomes in some cells of *Alydus* come to-

gether already in diakinesis (Reuter, '30),⁵ and the XY pair of several pentatomids undergoes its brief union in the interkinesis or even the telophase prior to its disjunction. These cases seem to bespeak the existence of some kind of attraction and the following case lends additional support to such an argument.

In the male of the hemipter *Rhytidolomia senilis*—as has been pointed out elsewhere (Schrader, '40)⁶—the meiotic tetrads are formed by the terminal union of homologues in diakinesis. This is true also of the sex chromo-



Rhytidolomia senilis

Figures 1 and 2. The sex chromosomes in diakinesis. They show the equational split and have come together terminally at their euchromatic ends. The heterochromatic ends are not fully condensed. The larger X is on the right.

Figures 3 to 5. Progressive stages in the division of the sex chromosomes in the first division. Poleward movement occurs with the large of heterochromatic end foremost. The X is on the right.

Figure 6. Late telophase of interkinesis with X and Y beginning to show orientation toward each other.

Figure 7. Metaphase or early anaphase showing the large ends of X and Y oriented toward each other. Probably they are here already beginning to separate.

Figure 8. Late anaphase showing the loss of the club shape in the sex chromosomes.

somes; but it is to be noted that the X and Y chromosomes are each composed of a euchromatic and a heterochromatic section and that their diakinetive union always occurs at the euchromatic ends. This fact can be determined with little difficulty by tracing the chromosomes through the prophase. But it can also be demonstrated in the fully condensed chromosomes because both the X and the Y are clubshaped and the narrow end where the union takes place represents the euchromatic section (Figs. 1 to 3).

The first division is, superficially at least, equational for both sex chromosomes. Their movement to the poles always occurs with the large or heterochromatic end foremost. Already in the initial steps of the division all connection between the *X* and *Y* disappears (Figs. 4 and 5), but in telophase or interkinesis they become reassociated. However, in contrast to the union that takes place during diakinesis, they now come together at their large or heterochromatic ends. The approach usually begins already in late telophase when the metaphase grouping of the chromosomes has become temporarily lost (Fig. 6). The final union appears to be nothing more than a contact. In some cells a tiny gap can be seen between the two chromosomes and is then often bridged by an achromatic connection—but it is difficult to decide whether such cases do not represent the initial step in the reductional separation of the *X* and *Y* in the second division (Fig. 7). In the late second anaphase the clubbed shape of both sex chromosomes is obliterated (Fig. 8).

It is natural to conclude that this interkinetic maneuver of the *X* and *Y* is in some way correlated with the properties of heterochromatin. But whether it is or not does not touch the question here at issue. Also it may be granted that the interplay of mitotic forces is to some degree acting in any grouping of chromosomes on the spindle (distance conjugation makes this almost certain). But by the same token the *Rhytidolomia* case furnishes strong evidence that the touch-and-go movement involves not only an attraction between the *X* and *Y*, but an attraction of a very specific type.

¹ Lorbeer, G., *Jahrb. wiss. Bot.*, **80**, 567–818 (1934).

² Wilson, E. B., *The Cell*, pp. 1–1232 (1925).

³ Wilson, E. B., *Jour. Morph.*, **53**, 443–468 (1932).

⁴ Darlington, C. D., *Jour. Genet.*, **39**, 101–136 (1939).

⁵ Reuter, E., *Act. Zool. Fenn.*, **9**, 1–484 (1930).

⁶ Schrader, F., *Jour. Morph.*, **67**, 123–136 (1940).