

Chiasma-Like Formations in the Bivalents of Male *Sarcophaga ruficornis* Fab. - Family Sarcophagidae, Diptera

COOPER¹⁻⁴ has adduced a considerable amount of evidence and arguments to show that DARLINGTON's⁵ hypothesis of the existence of two reciprocal chiasmata underlying the conjunction of sex-chromosomes in male *Drosophila pseudoobscura*, is untenable. Further, COOPER^{1,4} has shown that, in the males of *Melophagus* and *Olfersia*, chiasma formation does not take place, although the bivalents appear as if they were chiasmally connected.

The study of meiosis in the spermatocytes of *Sarcophaga ruficornis* has yielded some interesting information bearing on the question mentioned above, and is therefore being reported in this communication. Somatic pairing is expressed in varying degrees in different chromosome pairs in spermatogonial prophase (Figure 1). Later prophase (Figure 2) shows most of the chromosomes split into two chromatids, in one limb or both (joined by a common unsplit centromere). Sometimes the extremities of two sister-chromatids are associated with the corresponding extremities of their homologous chromatids, simulating the appearance of a terminalized chiasma. Such apparent chiasmata, however, are not chiasmata at all. In *Drosophila melanogaster*, KAUFMANN⁶, and later, COOPER⁷, encountered such configurations in somatic mitoses very frequently, which they designated as chiasmata. KAUFMANN⁶ and COOPER⁷ hold, for genetical reasons, that these chiasmata do not involve crossing-over and arise through alternate openings of reductional and equational loops. In our opinion there is no reason to hold that these connexions are chiasmal in nature: they arise from mere contact between distal extremities (also distal segments) of

homologous chromatids, which is ascribable to the operation of the somatic pairing forces. This is borne out by the fact that of the numerous configurations examined and figured by KAUFMANN⁶ and COOPER⁷, not one bears an interstitial chiasma. KAUFMANN⁶ indeed does mention that he came across a pair of chromosomes bearing three chiasmata (one of which, of course, must be interstitial). But this is the only instance and it is not sketched.

At the spermatogonial metaphase, which shows five pairs of autosomes and an X- and a Y-chromosome, again, the operation of the pairing forces is evident (Figures 3 and 4).

The early meiotic prophase stages are undecipherable. At diakinesis, three large autosomal bivalents nearly always seem to bear chiasmata, the apparently largest one usually bearing one interstitial and two distal chiasmata. The sex bivalent is found to be devoid of chiasmata and is markedly heteropycnotic. Out of the remaining two autosomal bivalents, one is occasionally found to bear apparently two terminal chiasmata (Figures 5 and 6). At metaphase I, however, no bivalent ever bears more than two chiasmata, the interstitial one in the bivalent with three chiasmata at diakinesis having become resolved (Figure 7). In some cells, this resolution is effected as early as diakinesis. This is shown by the fact that, in such a bivalent, the points corresponding to the interstitial chiasma, although not in contact, are appreciably inclined towards each other, in contrast to the remaining proximal regions of the paired chromosomes, which are bowed away from each other (Figure 6). This resolution can be effected only if this interstitial interconnexion involves two reciprocal chiasmata of a restricted type, one that prevents interlocking (see COOPER⁴). It is more likely, as COOPER has argued in detail for *Olfersia*, that such connexions are non-chiasmal in character and result from adhesion of pairing segments at special foci. This view is further supported by the fact that, at the first anaphase, no chromosome shows a split into chromatids (Figure 8), which must happen when the distal chiasmata are broken and the paired chromosomes separate away. However, BARIGOZZI and SEMENZA⁸ and BARIGOZZI and PETRELLA⁹ have found chiasmata in the bivalents of the spermatocytes of *Aphiochaeta xanthina*.

The evidence from the present material favours the view that the chromosomal interconnexions found in it are non-chiasmal in character.

Zusammenfassung. In den Spermatocyten von *Sarcophaga ruficornis* zeigen drei autosomale Bivalente scheinbare Chiasmata. Aus dem Vergleich der verschiedenen Stadien kann aber geschlossen werden, dass es sich nicht um Chiasmata, sondern um Berührung der Chromosomen an speziellen Punkten handelt. Auch chiasmaähnliche Bildungen homologer Chromosomen in der Mitose sind als Bindung homologer Chromatiden der geteilten Chromosomen aufzufassen.

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Fig. 1. Early spermatogonial prophase. Fig. 2. Late spermatogonial prophase. Fig. 3. Spermatogonial metaphase. Fig. 4. Spermatogonial metaphase. Fig. 5. Late diakinetin nucleus. Fig. 6. Late diakinetin bivalents, drawn separately. Fig. 7. First meiotic metaphase, sex bivalent missing. Fig. 8. Late first anaphase. One univalent missing.

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³ K. W. COOPER, Proc. Nat. Acad. Sci. Wash. 30, 50 (1944).

⁴ K. W. COOPER, Genetics 29, 537 (1944).

⁵ C. D. DARLINGTON, Genetics 19, 95 (1934).

⁶ B. P. KAUFMANN, J. Morph. 56, 125 (1934).

⁷ K. W. COOPER, J. Morph. 84, 81 (1949).

⁸ C. BARIGOZZI and L. SEMENZA, Amer. Nat. 86, 123 (1952).

⁹ C. BARIGOZZI and L. PETRELLA, Exper. 9, 337 (1953).