Distribution of Chiasmata in an 'Asynaptic' Locust

THE relationship between the length of the chromosomes and the frequency with which they form chiasmata at meiosis is well known and has been analysed extensively by Darlington[1], Mather[2] and others. In general, it is found that long chromosomes form more chiasmata than short chromosomes in the same nucleus. The chiasma frequency, however, is not always found to be directly proportional to length, that is, the potential for forming chiasmata varies between chromosomes to some degree independently of their length. The details of such variation could be investigated in most favourable circumstances during observations made in *Locusta migratoria*. These are briefly described below.

An exceptional male in one family was found with an abnormally low chiasma frequency at meiosis during which univalents appeared in a high proportion of spermatocytes. This example of asynapsis is, so far as I know, the first recorded for this species. Because the chromosomes can be classified into groups of different lengths the relative frequencies with which they form, or fail to form, chiasmata under these conditions can readily be ascertained for the chromosomes in different groups. In the male locust there are eleven pairs of autosomes and one *X*. The classification and measurements, after Mather[3], are given in Table 1.

Table 1

Chromosome pairs	*L*(2)	*LM*(1)	*M*(5)	*S*(3)
Length in μ	5·3	3·9	2·9	1·2

In the asynaptic and other males in this family there were supernumerary chromosomes in a proportion of the spermatocytes[4]. These had no detectable influence on the chiasma frequency.

The diplotene chiasma frequencies of the asynaptic male are plotted against chromosome-length in the graph. Also plotted, for comparison, are the chiasma frequencies in a normal sib. It will be seen that the response to the abnormal, probably genotypically determined, conditions causing asynapsis is not the same for all classes of chromosomes. The reduction in chiasma frequency is relatively much greater in the *L* and *LM* chromosomes than in the *M* and, in particular, the *S* chromosomes. A further comparison suggests more precisely how the differences between the groups arise. This comparison takes into account the frequencies with which their members completely fail to form chiasmata, that is, produce univalents. The data are given in Table 2.

Table 2. CHIASMA FREQUENCY

	Less than one	One or more
L	12	38
LM	7	18
M	12	113
S	2	73

We see that only exceptionally are the *S* chromosomes unable to form at least one chiasma in the asynaptic male. As the graph (Fig. 1) shows, their average, about 1, is virtually the same in both normal and asynaptic individuals. The longer chromosomes, on the other hand, fail to form one chiasma with a significantly higher frequency ($P = < 0·01$). This, as distinct from their forming fewer chiasmata over and above one, accounts for a large part of the reduction in their chiasma frequencies.

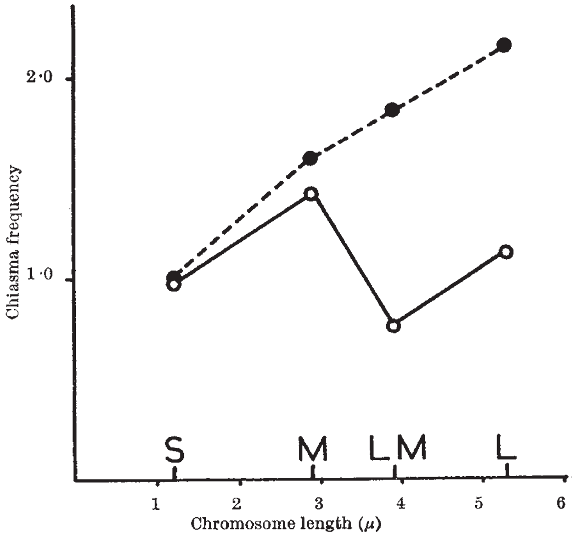

Fig. 1. The chiasma frequencies at diplotene plotted against chromosome-length in an asynaptic and a normal male locust. Data from thirty-five cells in each. Asynaptic, ○ ; normal, ●

From the earlier results[1,2], based mainly on observations in normal diploids of a number of species, it was concluded that short chromosomes were endowed with special, distinctive, properties in respect of their ability to form at least one chiasma during meiosis. The disproportionately high frequencies with which the longer chromosomes form univalents under the conditions of asynapsis described above confirm this conclusion in a decisive fashion. No doubt, as the earlier authors suggested, the difference between long and short chromosomes is adaptive, securing, in normal circumstances, regular pairing within nuclei the chromosomes of which vary widely in length, and where, as in locust, the average chiasma frequency per bivalent is comparatively low.

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Changes in Response to Light Stimuli of the Larvæ of *Culicoides circumscriptus*

WHEN the larvæ of *Culicoides circumscriptus* are extracted from the mud of their natural habitat the great majority exhibit a negative phototaxis. If they are kept in water without food over a period of time many become positively phototactic. The percentage of larvæ which undergo this reversal increases rapidly for 6–7 days and thereafter remains fairly constant at a level of between 60 and 90 per cent of their total number.

If food is given to the larvæ at this stage there follows a sudden drop in the proportion of photopositive individuals. In some experiments the food given consisted of chopped-up blowfly larvæ, which is not the natural food of the larvæ of this species of *Culicoides* and, after the initial drop, the proportion