Recovery of the Complementary Products of Mitotic Crossing-over

THE elegant analysis of mitotic crossing-over and segregation in *Drosophila melanogaster* by Stern[1] provided a model for comparison when an apparently similar process was observed by Pontecorvo *et al.* in diploid strains of *Aspergillus nidulans*, *Aspergillus niger* and *Penicillium chrysogenum*. The results obtained in *Aspergillus nidulans* have been entirely consistent with the interpretation by Stern; that is, mitotic crossing-over occurs such that at any one point only two of the four strands recombine and segregation of the centromeres is of the mitotic type[2].

Further support for this interpretation has now been obtained by the recovery, within a single diploid nucleus, of the reciprocal products of mitotic crossing-over. The technique used was based on recombination between alleles making use of the well-known position effect[3] usually shown by allelic mutants originated by independent mutation $\left(\frac{m_1\ +}{+\ m_2} = \text{mutant}, \frac{m_1\ m_2}{+\ +} = \text{normal}\right)$. We have assumed that, for the present purpose, crossing-over between alleles is not essentially different from that between non-allelic mutants.

A diploid *Aspergillus* (1) was prepared[4] heterozygous for a number of linked markers and carrying in the *trans* arrangement the two allelic mutants ad_{16} and ad_8. Phenotypes of the various haploid and diploid combinations of ad_{16} and ad_8 are shown in Fig. 1. (For other markers, see ref. 5.)

If the supposed mechanism of mitotic crossing-over is correct, then two distinguishable types (2 and 3) of adenine-independent recombinants would be expected following a single mitotic cross-over between the *ad* alleles. Type 2 would result from the inclusion within the same nucleus of the reciprocal products of crossing-over. Type 3 would result from the inclusion within the same nucleus of the chromatid carrying the wild type *ad* alleles with the non-cross-over chromatid.

Conidia of diploid 1 (adenine-requiring) were plated on a medium lacking adenine, and adenine-independent diploids selected. These represented

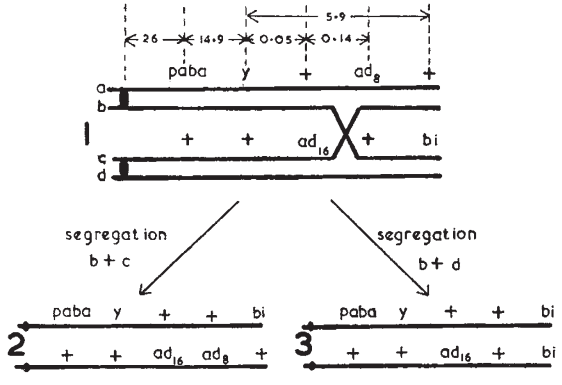

Fig. 1. Origin of recombinant nuclei. Distances in centi-Morgans

Strain	Phenotype on minimal medium
$ad_{16}+$	reduced growth
$+\ ad_8$	no growth
$ad_{16}\ ad_8$	no growth
$\frac{ad_{16}+}{+\ ad_8}$	reduced growth
$\frac{ad_{16}\ ad_8}{+\ +}$	full growth

only about 1 in 10^7 of tested nuclei. The majority of the adenine-independent types were shown, by recovery and out-crossing of haploids, to have either genotype 2 or 3.

The determination of genotype with respect to the *ad* alleles was made possible by the fact that ad_{16} and ad_8 determine slightly different phenotypes. The haploid double mutant $ad_{16}ad_8$ is phenotypically indistinguishable from the ad_8 type (that is, the most extreme mutant), but can be distinguished from it by out-crossing and recovering the less extreme type (ad_{16}). Similar results have also been obtained using alleles determining requirement for *p*-aminobenzoic acid[6].

These results support the mechanism of mitotic crossing-over and segregation as outlined above. Furthermore, the technique used has led to the recovery of nuclei carrying two mutant alleles in the *cis* arrangement. The great difficulty of succeeding in this with nutritional mutants of micro-organisms is apparent[7].

Whether one selects the complementary or non-complementary products of mitotic crossing-over, the technique outlined above offers an approach for the analysis of half-tetrads. One of us (R. H. P.) has already used the technique for this purpose.

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Vibrations of the Substrate and Stridulation in a Grasshopper

OBSERVATIONS made during experiments to determine the behaviour associated with stridulation in *Chorthippus parallelus* (Zett.) (Orthoptera, Acrididae) suggested that, in certain cases, females the tympanal organs of which had been destroyed were reacting to vibrations of the substrate caused by the act of stridulation in the male. Since it has been shown by Autrum[1] that Orthopteroid insects possess a receptor, the so-called sub-genual organ, which is sensitive to vibration, it was thought that preliminary experiments to determine whether a stridulating insect does produce any measurable vibration of the substrate would be of interest.

Adult mature males of *C. parallelus* were placed on hard-packed bare earth in a large metal tray mounted on thick sponge rubber. A 'Rothermel' vibration pick-up, type *V.P.*5, was suspended in sponge rubber so that its tip just touched the soil, the centre of the insect arena being 15 cm. from the pick-up. The latter fed into a high-gain amplifier with variable band-pass filters, the output of which was displayed on one trace of a double-beam oscilloscope. The other beam of the oscilloscope was fed