A system to test for non-random disjunction

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Abstract
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The present genetic tests have shown that it is possible to induce, recover, maintain, and analyze recessive lethal mutations resulting from presumptive deletion of particular linked loci in balanced dikaryons of Neurospora. It is noteworthy that none of the ad-3 mutations were associated with (1) gross deletions covering the major portion of the right arm of LGF, or with (2) terminal deletions. These results are entirely consistent with those of Atwood and Mukai (Radiation Res. 1: 125, 1954).

This system is now being used to study the kinetics of survival and mutation-induction, and to analyze the types of induced ad-3 mutants as a function of X-ray dose. ---Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Operated by Union Carbide Corporation for the United States Atomic Energy Commission.

Horowitz, N. H. Irreparable mutants in Neurospora. Continued interest in the problem of "indispensable" gene functions in Neurospora (Curtis, NN #2, 7) prompts the following comments. The frequency of occurrence of irreparably lethal mutations has been estimated by two methods: the temperature-mutant method (Horowitz, Adv. in Genetics 3, 33, 1950; Horowitz & Leupold, Cold Spring Harbor Symp. 16, 65, 1951) and the heterocaryon method (Atwood & Mukai, P. N. A. S. 39, 1027, 1953). As is well known, there is a large discrepancy between the two estimates, the temperature-mutant method giving the lower estimate. Atwood & Mukai explained the difference by postulating a class of genes which does not yield temperature alleles and which controls only indispensable functions. A simple calculation shows that approximately 85% of the genes of Neurospora would have to belong to this class in order to account for the discrepancy.

It has always seemed to me that a more plausible explanation exists. In the temperature-mutant experiments, the frequency of irreparable mutations was determined against a wild-type genetic background and on standard complete medium. In the heterocaryon method, however, this frequency was measured in nuclei which carried the mutants amycelial and methionineless, and counts were made on sorbose-complete. One may reasonably ask whether all mutations that are scored as reparable by the temperature-mutant method would be so scored if placed in any amycelial-methionineless background and on sorbose medium. I strongly suspect that this would not be found to be the case, but that many morphologicals and reparable auxotrophs would be registered as irreparable lethals under the conditions of the heterocaryon method. This could be tested by extracting mutants from the amycelial-methionineless background and testing them on standard (sorbose-free) complete. About half of the "irreparable lethals" should prove to be recoverable if the view expressed here is correct. ---California Institute of Technology, Pasadena, California, U.S.A.

Suzuki, D. T. A system to test for non-random disjunction. In Drosophila females, the products of meiosis are oriented in a row of four similar to the orientation of ascospores within the ascus. Sturtevant and Beadle (1936, Genetics 21: 554-604) found that exchange within inversion heterozygotes did not increase zygote mortality but resulted in the recovery of non-exchange chromatids or patroclinous offspring. They postulated, therefore, that, of the four nuclei, either of the outer nuclei only could be fertilized and that dicentric bridges were retained in the center nuclei. Novitski (1951, Genetics 36: 267-280) and Novitski and Sandler (1956, Genetics 41: 196-204) demonstrated that when asymmetrical dyads are formed by a crossover event within a tetrad, the shorter member of the dyad is recovered, i.e., is included in the outer nuclei, more frequently than the longer member.
If the chromosome mechanics of unrelated organisms have common features, Neurospora could provide a cytological demonstration of non-random disjunction. Dr. de Serres and coworkers (personal communication) are studying various heterokaryotic systems to attempt to recover deletions involving the right arm of LGI. With such a system it should be possible to recover terminal or gross deletions involving a large part of the linkage map to the right of the ad-3 region. By appropriate matings, it should be possible to obtain such a deletion with its normal homolog in a meiotic nucleus. Perithecial squashes would permit scoring of asci for first and second division segregation by patterns of spore abortion. By scoring second division segregants resulting from an exchange between the breakpoint and the centromere of the right arm of LGI, the frequency with which the deletion (aborted spore) reaches the outer pair of nuclei can be determined. Any deviation from the expected 50:50 ratio might indicate non-random disjunction. Translocation heterozygotes could be tested in a similar manner. As a control, abortion patterns of asco would indicate the distribution of aborted spores in tetrads having no gross chromosome aberrations. ---Department of Genetics, University of Alberta, Edmonton, Alberta, Canada.