Alexandrov, Y.N. and M.D. Golubovsky. Institute of Molecular Biology and Genetics, Kiev; Institute of Cytology and Genetics, Novosibirsk, USSR. The multisite mutations induced by viruses and foreign DNA can spread in natural populations of Drosophila.

The mutagenic action of DNA and RNA-containing viruses and foreign DNA is well established. But from a population point of view, it is quite important to test directly whether mutations induced by these agents can really spread in nature. The possibility of answering this question appeared after comparing two sets of second chromosome lethals obtained and analyzed during many years in two laboratories: (a) induced by DNA and RNA viruses and foreign DNA (Alexandrov et al. 1971; Gershenson et al. 1975), and (b) isolated from natural populations in the USSR (Golubovsky et al. 1974). Both sets of lethals were studied for allelism and some of them were localized.

The mutagenic effect both of various viruses non-infectious for Drosophila and foreign DNA is characterized by strong site-specificity. Analysis of even small samples consisting of 15-20 lethal chromosomes shows complex allelic reactions and high allelism frequency. The mutations occur in definite groups of loci specific for each agent tested (Alexandrov et al. 1971; Gershenson et al. 1975). The chromosomes with lethal defects in many sites (multilethal) appear regularly (for example, see Fig. 1). The mutant loci are either clustered or dispersed among the chromosome.

On the contrary, allelic relations of large groups of lethals isolated from nature are rather simple. The mutations usually appear in a great number of loci. Some lethals, however, have been found repeatedly both within one population and among adjacent ones. The multilethal chromosomes were also isolated.

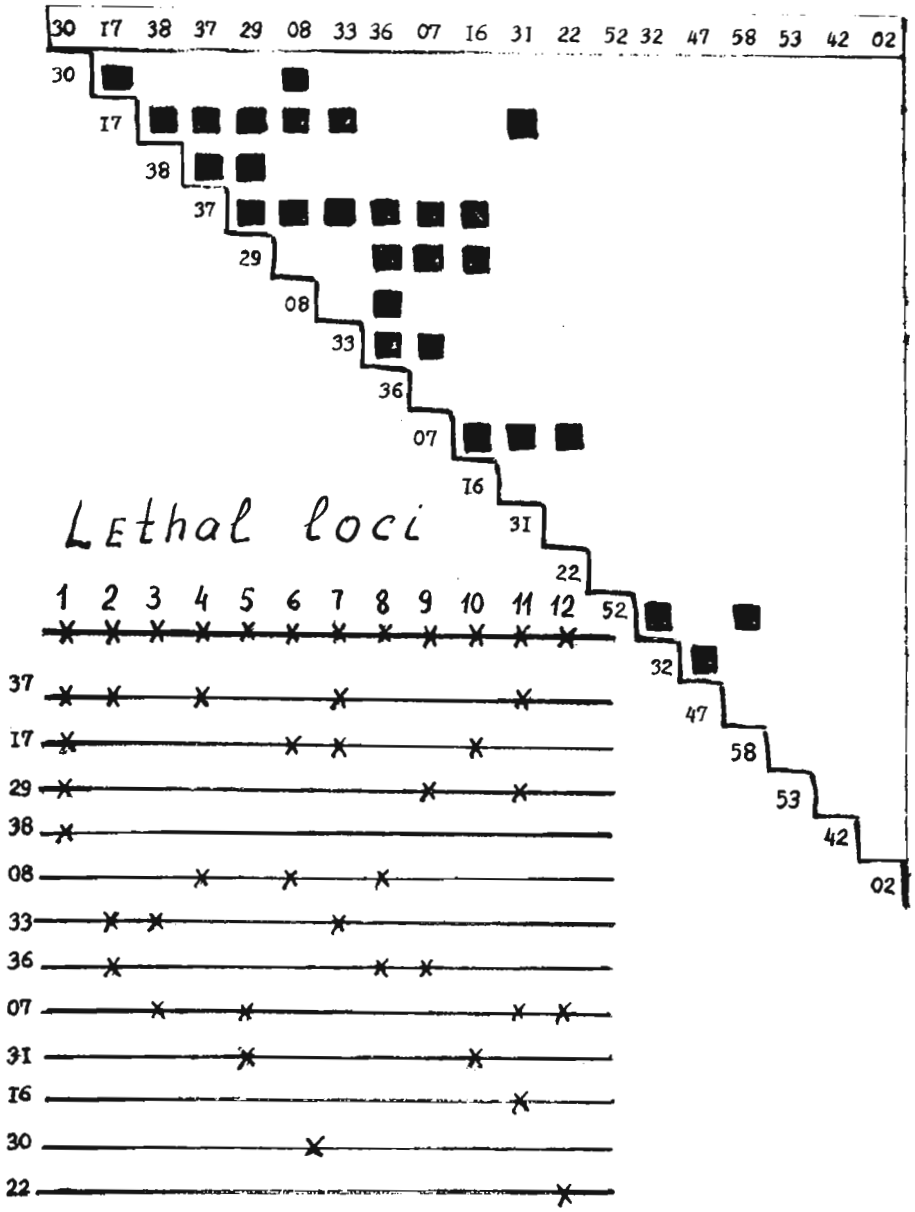

Fig. 1. Diallelic crosses between 19 second chromosomes in which lethals were induced by addition of influenza virus in food. Allelism is shown by black squares. Allelic relationships are complex; their interpretation is given at left. Mutations occur in 12 loci; 8 chromosomes are multilethal and have 2-5 lethals in different loci. The order of loci is given here arbitarily. Chromosomes 52 and 32 are dilethal. So among 19 lethal chromosomes 10 are multilethal; they occur due to single mutational events.

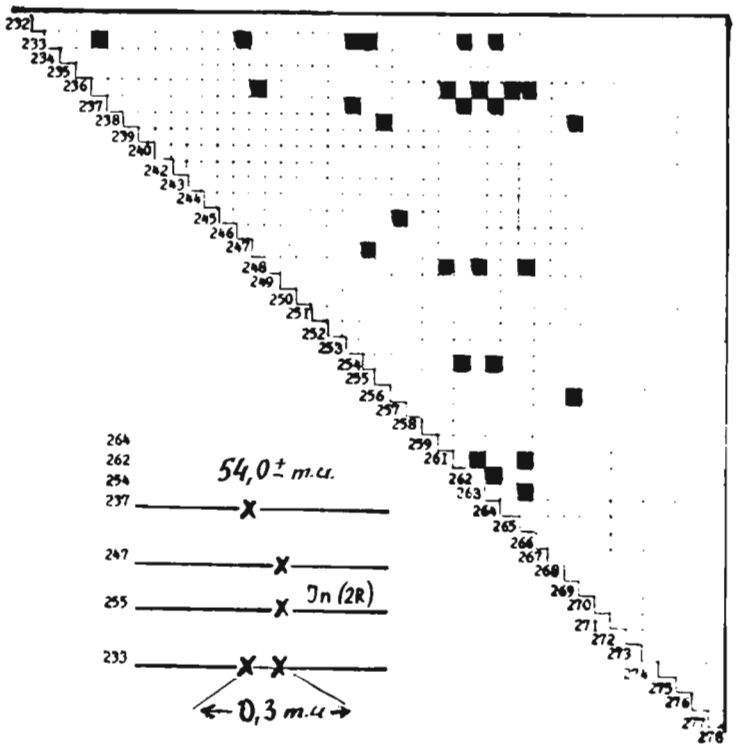

Fig. 2. Diallelic crosses between 45 chromosomes with lethals isolated from a natural population in Dilizhan (Armenia) in 1964. Allelic relationships as a rule are simple. One exclusion is shown at left. Chromosome 233 contains two closely linked lethals; both of them were allelic to the virus-induced mutations (see Table 1). Chromosome 255 carries a short inversion on the right arm, In(2R) 51A;57B.

(see Fig. 2). Among these groups of natural lethals we found allelism with the lethals induced by viruses and foreign DNA (see Table 1).

The main conclusions are: (1) mutagenic action of different viral agents and foreign DNA sources causes the multisite mutations which may be distributed in natural populations; and (2) this form of mutagenesis is similar to the action of movable genetic elements (Lim 1979; Berg et al. 1980; Engels and Preston 1981). In both cases the site-specific chromosomal lesions (including rearrangements) may occur due to single mutation events. Similar multisite mutations may appear repeatedly and independently in isolated populations.

References: Alexandrov, Y.N., S.M. Gershenson and S.S. Maliuta 1971, Genetika (USSR) 9:102-112; Berg, R.L., W.K. Engels and R.A. Kreber 1980, Science 210:427-429; Engels, W.R. and C.R. Preston 1981, Cell 26:421-428; Gershenson, S.M., Y.N. Alexandrov and S.S. Maliuta 1975, Mutagenic action of DNA and viruses in Drosophila, "Naukova Dumka" Publ. House; Golubovsky et al. 1974, Genetika (USSR) 4: 82-92; Lim, J.K. 1979, Genetics 93: 681-701.

Table 1. Results of allelism tests between two sets of mutations: (1) 72 lethals induced by viruses and foreign DNA: and (2) 64 lethals found repeatedly in natural populations.

Mutagenic agent and number of lethal chromosomes tested with natural ones		Cases of allelism	Lethals isolated from nature: Index, population, and year of collection			Inclusion in the multilethal chromosome
Algae phage (DNA)	8	1	237;264	Dilizhan	1964	yes
Influenza virus (RNA)	10	2	247;255	Dilizhan	1964	yes
Herring DNA	10	2	137	Uman	1963	yes
			305	Uman	1965	no
Calf thymus DNA	29	5	97	Uman	1963	yes
			121	Uman	1963	no
			181	Uman	1963	yes
			587;654	Uman	1967	yes
			701	Uman	1967	yes
Drosophila Picorna-virus C type (DCV)	5*	1	108	Uman	1963	no
Drosophila DNA	10	0				
Total	72	10				

*Lethals were induced in C Picornavirus infected line Paris-Renner (see Golubovsky, M.D. and N. Plus 1982, Mut. Res. 103:29-32).

**The induced lethals were also tested for allelism with lethals found only one time in nature or spontaneously occurring in the laboratory in the progeny of wild flies (as a control). Among 5000 crosses no case of allelism has been found.