

for genetic mutations at specific gene loci in sperm and spermatogonial cells. Differences in radiation damage after treatment of mature germ cells and premeiotic spermatogonial cells are discussed.

- 760 Alexander, M.L. THE EFFECTS OF RADIATIONS ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSIOLOGICAL AND BIOCHEMICAL SYSTEMS. Progress Report, May 1, 1960 - April 30, 1961. TID-17003, Texas. Univ., Houston. M.D. Anderson Hospital and Tumor Inst. 15p.
- Results are reported of experimental tests for recovery systems that act after radiobiological damage, and of studies on the types of genetic damage induced and the recovery of mutational types of damage from spermatogonial cells of *Drosophila virilis*. Dose rate studies with γ -rays in anoxic and oxygenated atmospheres were employed in investigations of post-irradiation methods for reducing genetic damage. Higher values for dominant lethals were recovered from spermatogonia after irradiations with 22-MV x-rays than with 200-kV x-rays. Investigations were made of chromosome breakage, cell degeneration, genetic damage, and mutational studies of sex-linked and autosomal loci. Direct comparisons were made of loci on the sex chromosome and the autosomal loci in sperm and spermatogonial cells. (From NSA 16: 1962, 1239).
- 761 Андреев, С.В., Мартенс, Б.К., Молчанова, В.А., Степанов, А.С. ИССЛЕДОВАНИЕ ВЛИЯНИЯ ДОЗЫ ОБЛУЧЕНИЯ НА СМЕРТНОСТЬ И ПОЛОВУЮ СТЕРИЛИЗАЦИЮ АМ-БАРНОГО ДОЛГООСИКА. Радиобиология 2, 5 (1962) 758-62.
- Andreev, S.V., Martens, B.K., Molchanova, V.A., Stepanov, A.S. STUDY OF THE DOSE-DEPENDENCE ON THE SURVIVAL RATE AND THE SEXUAL STERILIZATION OF THE GRANARY WEEVIL (*Calandra granaria*). Radiobiologiya 2, 5 (1962) 758-62.
- In order to determine the lowest industrially usable dose, studies were carried out on the mortality, sterility, and the reduction of the biological activity of the granary weevil. A 50 g equivalent Ra-Co⁶⁰ source was used for the tests, regulating the dose by adjusting the distance. Groups of insects were exposed to 0 r, 1, 8, 12, 20 and kr of radiation. The results have indicated that exposure to doses between 0.6 and 1 kr exerts partial lethal and sterilizing action; complete sterilization is reached at about 8 kr. (From NSA 17: 1963, 6368).
- 762 Baldwin, W.F. RADIATION INDUCED STERILITY IN *Rhodnius prolixus*. p. 8 in "Radiation Biology in Canada 1962-63", CRB-1129, AECL-1701, Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 1963. 60p.
- The doses of x-irradiation required to sterilize *R. prolixus* in the nymphal and adult state and the effects of this sterility in limiting the growth of laboratory-reared populations is being investigated. (Auth.)
- 763 Baldwin, W.F., Shaver, E.L. RADIATION-INDUCED STERILITY IN THE INSECT *Rhodnius prolixus*. Canad. J. Zool. 41 (1963) 637-48.
- Immature 5th instar *Rhodnius* nymphs and adults of both sexes were exposed to various doses of 2 MVP x-rays, chosen to produce reductions in fertility up to and including complete sterility. In male insects irradiated as 5th instar nymphs and reared to the adult stage, sterilizing doses interfered with mating, thus making these males useless as a means of inhibiting the growth of populations into which they are introduced. Exposure in the adult stage, on the other hand, had less effect on mating behaviour. Thus, with a very high dose (17 500 r) and high ratios of sterile to fertile males, a substantial reduction occurred in percentage of viable eggs from normal females. However, this was true for the 1st month only. In the 2nd and 3rd months, the effect on population fertility disappeared, a result of the early deaths of irradiated males. Greater effectiveness in limiting population growth over extended periods might be expected to result from the introduction of males that had been partially sterilized by exposure to lower doses. (Auth.)
- 764* Bateman, A.J., Chandley, A.C. EFFECTS OF X-RAYS ON FEMALE GERM-CELLS OF *Drosophila melanogaster*. I. DOMINANT LETHAL MUTATION AND OVIPOSITION IN RELATION TO TREATED STAGE. Int. J. Rad. Biol. 7, 4 (1963) 385-94.
- The sensitivity in terms of dominant-lethal induction (strictly speaking: reduced hatchability) has been measured for successive eggs laid by *D. melanogaster* after irradiation of the female with 1000, 4000 and 6000 rad.
- Hypersensitivity is found in eggs laid by females aged 7 d, during the first 12 h after irradiation. This is attributed to irradiation of Metaphase I. A lower level of sensitivity is found in eggs laid over the next

six days. This is attributed to the irradiation of oöcytes in all stages prior to Metaphase I. Finally, a residual incidence of dominant lethals is observed in eggs laid more than 6 d after irradiation, which are presumed to have been irradiated as oögonia. Oviposition (i.e. rate of maturation of eggs) shows an entirely different radiation response. 4000 rad produces a slight depression of egg-laying during the period of low dominant-lethal production, a more marked depression coinciding with the main production of dominant lethals, and a particularly severe depression on day 3 after irradiation. The pattern of sensitivity after 6000 rad is the same but more marked. The egg-laying rate more than 6 d after irradiation is slightly depressed by 4000 rad, and more so with increasing doses until 10 000 rad, when complete sterility is produced. After such a dose the ovarioles are atrophied, without oöcytes or oögonia. (Auth.)

- 765 Bleschly, J.D. EFFECTS ON SUBSEQUENT GENERATIONS AFTER γ -IRRADIATION OF LARVAE OF *Lyctus brunneus* (STEPH.) (COLEOPTERA, LYCTIDAE). Ann. appl. Biol. 50 (1962) 661-7.

The effects of a single irradiation at 4000 r on larvae of the powder-post beetle *L. brunneus* (Steph.) are described. These included a reduced and delayed emergence of the 1st generation. The number of beetles produced per female returned to normal in subsequent generations. The vigour of emerged beetles as judged by their average weights did not appear to be much affected. Irradiation at a sublethal dosage thus seems unlikely to be a practical method of employing γ -radiation for the treatment of infestations by wood-boring insects. One of the chief limiting factors in the employment of lethal dosages for such treatments is the mass of screening required, hence a technique enabling lower dosages to be used would be of value. (Auth. summary)

- 766 Boroughs, H. THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual report. p. 50-7 in TID-15341, Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica, 1 Mar. 1962 59p.

Work by K.P. Katiyar, J. Valerio and E. Ortiz on *Ceratitis capitata* (Wied.) is described, which includes moderately successful mass breeding studies. A Cs^{137} source (γ -field) was used, a new Co^{60} source (allowing greater precision) being expected. - Pupae (8-d) were irradiated at 1000 r/min and mated with non-irradiated females. Egg production and fertility were investigated over the range 4-13 kr. Male fertility decreased with increasing dose, some fertility still remaining at 13 kr. - P^{32} -labelled flies were produced for dispersal studies. After only 24 h access to labelled honey solution (3.8 $\mu\text{C}/\text{ml}$) adults remained identifiable even beyond 4 weeks. The biological loss of P^{32} from adults labelled either as larvae or adults is shown. Adult feeding is less expensive and equally effective. The distribution (maximum in thorax - ingestion; minimum in wings) is tabulated for different stages. Records are based on 10 individuals, both sexes, for concentrations of 1.0 $\mu\text{C}/\text{g}$ larval medium, and 75 $\mu\text{C}/20 \text{ ml}$ honey water solution. Experiments with Sr^{90} yielded insufficient radioactivity, Sr^{90} remaining in the pupal skin. - In addition to γ -irradiation, radiomimetic substances are being tried for inducing sterility.

- 767 Borstel, R.C. von. INDUCTION OF NUCLEAR DAMAGE BY IONIZING AND ULTRA-VIOLET RADIATION. p. 243-50 in "Progress in Photobiology. Proceedings of 3rd International Congress on Photobiology. The Finsen Memorial Congress, Copenhagen, 1960". Amsterdam, Elsevier Publishing Company. 1961.

The study of irradiated, unfertilized *Habrobracon* eggs was combined with the study of irradiated eggs fertilized by unirradiated sperm to detect different kinds of nuclear damage. Damage is used in the sense of induction of death of the cell either immediately after irradiation or after few or many mitoses occur. Types I to V lethality were studied and the probable cause of each was determined. During the study on the comparison of ultraviolet and ionizing radiation effects on the nucleus, it was concluded that ultraviolet radiation has a quantitatively different response than x-radiation. Discussion is included on the different effects of the two types of irradiation. (From NSA 16: 1962, 1821.)

- 768 Bull, J.O., Wond, T., Cornwell, P.B. A COMPARISON OF THE SUSCEPTIBILITY OF THE GRAIN WEEVIL (*Sitophilus granarius* L.) TO ACCELERATED ELECTRONS AND ^{60}Co GAMMA RADIATION. AERE-R-3890, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1961. 45p.

No difference could be detected in the numbers of emerged adults, rate of emergence or stage at death in the grain when two types of infested wheat, English and Manitoba, containing mostly pupae, were treated with γ -radiation and accelerated electrons. Mature adults were more susceptible to the killing and sterilizing effects of γ -radiation. The estimated LD_{50} was about 3000 rads higher for accelerated electrons than for γ -rays, the estimated dose for 50% reduction in progeny about 600 rads higher. The difference in dose for 99.9% mortality and sterility was about 5000 rads. Possible explanations of the

observed results are discussed. The likelihood of grain weevils providing a useful biological dosimeter in engineering studies for radiation disinfestation of grain holds little promise.

- 769* Carson, G.L., Braver, G. STUDIES OF THE SPOUSE EFFECT ON SPONTANEOUS AND X-RAY INDUCED LETHAL MUTATIONS IN Drosophila melanogaster. p. 44 in "Proceedings of 10th International Congress of Genetics, McGill University, Montreal, 20-27 August 1958. Vol. II". Toronto, University of Toronto Press. 1958.
- 770 Chandle, A.C. THE INDUCTION OF MUTATIONS IN SPERMATOCYTES OF Drosophila melanogaster WITH X-RAYS. Int. J. Rad. Biol. 5, 4 (1962) 305-22.
- F₁ males of D. melanogaster were irradiated with 1000 rads x-rays and mated 2♀/♂/d for 8d. Frequencies of dominant lethals, translocations, sex-linked lethals, deleted X's and induced crossing-over in the male were estimated for matings on d 5, 6, 7 and 8 following treatment. It is claimed that the sperm used in matings over these 4 sampling days was in the spermatocyte or early spermatid stage at the time of irradiation. Thus the frequencies of mutations recorded give an estimate of the relative sensitivities of these various stages of germ cell development to x-rays. Results show that sex-linked lethals and translocations follow similar patterns, reaching a peak on d 5, the level then dropping off through d 6 and 7 to a low value on d 8. Dominant lethals show an increase from d 5 to a high level on d 6 which is maintained over d 7 and 8. Deleted X's and induced crossing-over increase from d 5 through d 6 and 7 to reach a peak on d 8. The relationship between the type of aberration studied and the sensitivity pattern of the treated germ-cells is discussed. (From auth.)
- 771 Clayton, F.E. DEVELOPMENTAL-GENETIC STUDY OF THE EFFECT OF X-RAY IRRADIATION IN Drosophila virilis AND Sufo valliceps. Final Scientific Report, Jan.1, 1955- Dec.31, 1960. ORO-373, Arkansas. Univ., Fayetteville. 1 Mar. 1961. 115p.
- Normal spermatogenesis in D. virilis was studied by examining living cells by phase-contrast microscopy. Primary spermatocytes occurred in cysts of 8 cells. Histological analysis of sections from adult males indicated a 2d-cycle in meiosis until the males are sexually mature at 6 d. Following the 6th d the number of immature cells in the testes decreased steadily without further peaks in the number of primary spermatocytes on alternate days. Spermatozoa were not motile and functional until the 6th d. Typical configurations of chromosomes during spermatogenesis are presented. Results are included from a series of tests to determine the effects of irradiation on D. virilis males as measured by dominant lethal and translocation rates in cells at various stages of spermatogenesis and sperm differentiation. Males at different ages were irradiated under similar conditions and mated with mature virgin females within 1 h after irradiation and left for 5 d. No fertile eggs were deposited; the males were then remated to mature virgin females and daily egg counts made. After a 2 d-mating period, the males were remated and egg counts made. This procedure was continued for a total of 8 consecutive mating periods. Data are tabulated on rates of dominant lethals resulting from irradiation during various stages of spermatogenesis. (From NSA 15: 1961, 14119).
- 772 Crook, L.J. THE SUSCEPTIBILITY OF THE RUST-RED FLOUR BEETLE, Tribolium castaneum (Herbst.) TO GAMMA RADIATION. AERE-R-3889, United Kingdom Atomic Energy Authority, Research Group, Isotope Research Div., Wantage, Berks, England. 1962. 19p.
- All developmental stages of the rust-red flour beetle, T. castaneum, were treated at 30°C by γ-radiation from Co⁶⁰ with doses varying from 1000-19200 rads, at a dose rate of 4000 rads/h. Development of adults from irradiated eggs and larvae was completely prevented by 11200 rads. About 90% of adults emerged from pupae irradiated at 16000 rads but only 3% survived. A 50% kill of eggs was obtained by 5000 rads, of larvae by 4700 rads, of pupae by 10500 rads and of adults by 13200 rads. Only 1% of adults remained alive after treatment with 19200 rads. A 99.9% reduction in progeny was obtained after treatment of eggs, larvae and pupae with doses in excess of 8600 rads. Very slight fertility was observed in adults treated at 11200 rads. No recovery of fertility was detected after the irradiation of any developmental stage. All developmental stages of T. castaneum are more resistant to radiation than T. confusum. T. castaneum is also more resistant than Strophilus granarius except in the susceptibility of adults to sterilization. The dose evaluated for control of S. granarius (16000 rads) produces complete sterilization of T. castaneum, but allows 10% of the sterilized adults to survive. (Auth. summary).

- 773* Dal Monte, G. UTILIZAZIONE DEI RAGGI IONIZZANTI PER LA CONSERVAZIONE DEI CEREALI. (The use of ionizing radiation in the preservation of cereal products). Molindi Italia 10, 1(1959) 29-33. (In Italian).
- The section of the Conference on the Preservation of Foodstuffs by Ionizing Radiation (arranged by the FAO at the UKFA in Harwell, November 17-21, 1958), which was devoted to the disinfection and pest control of cereal products, is summarized. The behaviour of single species was investigated, and it was found that 6000 rep γ -radiation destroyed corn and rice weevils (Calandra granaria and C. oryzae, respectively) in 20 d and flour beetles (Tribolium castaneum) in 36 d after irradiation. At this level of radiation, no harmful chemical or organoleptic changes could be found. The second part of the report deals with economic aspects of pest control.
- 774 Davich, T.B., Lindquist, D.A. EXPLORATORY STUDIES ON GAMMA RADIATION FOR THE STERILIZATION OF THE BOLL WEEVIL. J. econ. Ent. 55, 2(1962) 164-7.
- The effect of γ -radiation on boll weevil (Anthonomus grandis Boheman) adults, pupae, and eggs was determined following exposure to Co⁶⁰. Longevity and egg-laying capacity of reproducing weevils were drastically reduced at doses of 5000 r or higher, whereas egg hatch was greatly reduced at doses as low as 2500 r. Exposure of virgin males to 10 000 r resulted in transient sterility whereas 15 000 r produced permanent sterility. However, these doses resulted in very rapid mortality of both sexes. A ratio of 3.8:1 of sterilized males:normal males:normal females did not affect egg laying or hatch. There appeared to be little, if any, effect of adult boll weevil age on susceptibility to the lethal effects of γ -rays. Emergence of adults from prepupae, young, and old pupae exposed to 10 000 r was eliminated, greatly reduced, and unaffected, respectively. However, the lethal effects carried over because all of the adults died within 2 weeks. Exposure of eggs to 600 r did not affect hatch or subsequent development whereas 2400 r drastically reduced hatch and prevented subsequent development. (Auth.)
- 775 De Bach, P., White, E.B. IRRADIATED PARASITIC WASPS, THE EFFECT ON PROGENY PRODUCTION AND SEX RATIO. J. Hered. 53, 8(1962) 271-6.
- Irradiation of adult Aphytis lingnanensis Comp. at dosages of 250, 500, 1000, 2000, and 4000 r produced: (1) no effect on longevity of the treated adults; (2) pronounced reduction in net fecundity with increasing x-ray dosage; (3) indications that mature eggs were less affected by x-ray treatment than the less mature ones; and (4) sharply reduced percentage of females in the progeny of those individuals which received the highest dosages. (BA 44: 1963, 254)
- 775-a De Fries, J.C., Touchberry, R.W. GENETIC EFFECTS OF RADIATION ON EGG PRODUCTION OF Drosophila melanogaster. (Abstr.) Genetics 47, 8(1962) 950.
- Studies were initiated by the authors to assess the genetic effects of radiation on biometrical traits. Both newly emerged males and females from Lucas's wild-type strain were subjected to various dosages of γ -irradiation (0, 500, 1000 and 1500 r) and mated in all possible combinations, resulting in a four \times four factorial arrangement of treatments. Three mating pairs were included in each subclass of two identical experiments, requiring a total of 48 mating pairs per generation. Mean daily egg production over a 10-d period of the treated females (generation one), their progeny (generation 2), and offspring (generation 3) resulting from a full-sib mating of generation two was obtained in both experiments. Somatic effects would be expressed in generation 1 whereas genetic effects would be expressed in generations 2 and 3. The significance of the linear and quadratic main effects of treatment on males and females, as well as the various interactions, were determined by orthogonal comparisons. In general, the results support previous evidence found by the authors that radiation-induced polygenic damage in surviving offspring is not large. (From abstr.)
- 776 Dickerman, R.C. THE INDUCTION OF DOMINANT LETHAL MUTATIONS IN x-IRRADIATED Drosophila virilis OOCYTES. Dis. Abstr. 23, 5(1962) 1492-3.
- To study the effect of various gases and combinations of gases on the induction of dominant lethal mutations in x-irradiated D. virilis oocytes two stages of oocytes were used. Females containing stage 7 oocytes were irradiated with 2000 r and females containing stage 14 oocytes were irradiated with 250 r. The flies were irradiated in the presence of 1 or 10 atmospheres (atm) of argon, He, methane, CO, air, O₂, or combinations of 9 atm of argon, He, or methane plus 1 atm of O₂. The percentage non-hatch was attributed to the induction of dominant lethal mutations. It was found that the LD₅₀ of mature oocytes (stage 14) irradiated in air is about 350 r while the LD₅₀ for stage 7 oocytes irradiated in air is about 2000 r. This demonstrated

that stage 14 oöcytes are much more sensitive to radiation damage than stage 7. Stages 7 or 14 oöcytes were irradiated in conditions of increased oxygen tension (10 atm air, 1 or 10 atm of O_2). The groups showed an increased induction of dominant lethals as scored by percentage non-hatch, when compared to oöcytes irradiated in one atmosphere of air. Stage 7 or 14 oöcytes irradiated in the presence of 9 atm of argon, He, or methane with 1 atm of oxygen showed a large decrease in induced dominant lethals when compared to oöcytes irradiated in 1 atm of pure O_2 . This demonstrates that argon, He, and methane have a protective effect against the induction of dominant lethal mutations. Stage 7 or 14 oöcytes irradiated in the absence of oxygen (presence of 1 or 10 atm of argon, He, methane, or CO) showed a large decrease in the induction of dominant lethal mutations when compared to oöcytes irradiated in 1 atm of air, thus showing that decreased O_2 in the oöcyte leads to decreased damage to the cell. Fewer dominant lethals were induced when the oöcytes were irradiated in 10 atm of argon, He, methane, or CO as compared to oöcytes irradiated in one atmosphere of the same gas. In preliminary investigations stage 7 oöcytes were irradiated in the presence of 10 atm of carbon monoxide with fractionated doses. A slight increase in the percentage hatch of the groups irradiated in two fractions as compared to the groups irradiated in one dose was observed. The differences in percentage hatch of the groups irradiated in fractionated doses were not statistically significant. Tentative evidence was presented that indicates that anoxia during fractionated doses or irradiation in stage 7 oöcytes does not increase the frequency of induced dominant lethal mutations. The work was subsequently published in Genetics 48 (1963) 311-9.

- 777 Dickerman, C. INDUCTION OF DOMINANT LETHAL MUTATIONS IN X-IRRADIATED Drosophila virilis OÖCYTES. Genetics 48 (1963) 311-9.

For abstract, see 776.

- 778 Erdman, H.E. EFFECTS OF IRRADIATING SINGLE AND MIXED SPECIES OF BEETLES. p.198-201 in "Hanford Biology Research Annual Report for 1960". HW-76000, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 10 Jan. 1961.

Effects on reproductive abilities, induced dominant lethals, and life spans were investigated for single- and mixed-species cultures of flour beetles, T. confusum and T. castaneum, given x-radiation. T. castaneum was more x-ray tolerant. Co-existence as well as 2 kr x-radiation reduced T. confusum progeny. (Auth.)

- 779 Erdman, H.E. X-RAY TOLERANCE OF TWO RELATED SPECIES OF BEETLES. p.156-9 in "Hanford Biology Research Annual Report for 1961." HW-72500, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 15 Jan. 1962.

Sterilizing and lethal x-ray doses were determined for various developmental stages of Tribolium confusum and T. castaneum. Under the experimental conditions, T. castaneum was more x-ray resistant than T. confusum. Radiotolerance of both species increased as development and differentiation progressed; the 1-3h oviposited egg was the most sensitive stage. (Auth.)

- 780 Ghosh, S.M., Hati, A.K., Basu, S.P. EFFECT OF GAMMA RADIATION ON THE FERTILITY OF Aedes aegypti. Bull. Calcutta Sch. trop. Med. Hyg. 9, 3 (1961) 111.

Exposure of adults of Aedes aegypti (L.) to γ -radiation in doses from 500 r up to 2000 r, in steps of 500 r, had no effects on longevity, feeding or mating habits. Exposure to 6000 r, the highest dose used, did not sterilize females or lessen their readiness to mate, though it did so with the males, and the few eggs that resulted from the mating of such males with normal or irradiated females failed to hatch. Half the eggs exposed to 2000 r were killed and development of the larvae delayed. Whereas eggs hatched and larvae developed normally after 1000 r, 3000 r killed almost all eggs. It is concluded that males of A. aegypti required a much lower dose of γ -ray exposure for sterilization than females, and that eggs can be killed by exposure between 2000 r and 3000 r.

- 781 Gómez, N.J.C., Fernández, M.J., Gallimore, J.C., Gross, A. EL EFECTO DE LAS RADIACIONES IONIZANTES SOBRE LA BIOLOGIA Y LA ECOLOGIA DEL Rhodnius prolixus, VECTOR PRINCIPAL DE S. cruzi EN VENEZUELA. p.185-93 in "4th Inter-American Symposium on the Peaceful Application of Nuclear Energy, Mexico City, 9-13 April 1962". Washington, D.C. Pan American Union, 1962.

See 782.

- 782 Gómez, N.J.C., Gallimore, J.C., Fernández, M.J., Gross, A. THE EFFECT OF IONIZING RADIATION ON THE BIOLOGY AND ECOLOGY OF *Rhodnius prolixus*, THE PRINCIPAL VECTOR OF *Schizotrypanum* (i.e. *Trypanosoma*) *cruxi* IN VENEZUELA. *Acta cient. venez.* 13, 2 (1962) 46-52. (In Spanish, with English summary).

Ionizing radiations in the systematic and detailed study of *Rhodnius prolixus* are discussed. Sterilization occurred when males were subjected to doses $> 10\,000$ r; motility and longevity were significantly reduced by $10\,000$ r and $40\,000$ r respectively. In progeny from irradiated males mutations were found which prevented normal development of the nymphs. The use of irradiated males also served to establish the absence of a "copulatory stoppage" in the female. Co^{60} was used for labelling in ecological studies, which showed the distribution in and outside houses. The results suggest changes in the concepts held to date on the behaviour of this vector in Venezuela.

- 783 Henneberry, T.J. EFFECTS OF GAMMA RADIATION ON THE FERTILITY AND LONGEVITY OF *Drosophila melanogaster*. *J. econ. Ent.* 56, 3 (1963) 279-81.

Untreated females of *D. melanogaster* Meigen mated with males exposed to 4 kr of γ -radiation in the larval, and 16 kr in the pupal or adult stage deposited the normal number of eggs, none of which hatched. Females irradiated in the pupal or adult stage with 8 or 16 kr and mated with untreated males produced few or no eggs. Females irradiated in the larval stage produced fewer eggs after exposure to high doses of gamma radiation than untreated females but showed no reduction in the percentage of emerging adults. The longevity of males or females exposed in the pupal or adult stage was not affected by the radiation treatment. Males and females irradiated in the larval stage were shorter lived than untreated insects. Untreated female flies mated with irradiated males (16 kr) produced sterile eggs, but when mated a second time with untreated males, produced viable eggs. Untreated female flies mated with normal males produced viable eggs, but when subsequently mated with irradiated males, they continued to produce viable eggs. Sterile males confined with normal males and females reduced the number of progeny. (Auth.)

- 784 Henneberry, T.J., McGovern, W.L. SOME EFFECTS OF GAMMA RADIATION ON FERTILITY OF *Drosophila melanogaster* AND VIABILITY OF SPERM AFTER MULTIPLE MATINGS OF MALES. *J. econ. Ent.* 56, 5 (1963) 819-22.

Untreated *D. melanogaster* Meigen females mated to males exposed to 16 kr of γ -radiation in the pupal or adult stage produced as many eggs as untreated females mated to untreated males, but few or no adults emerged. Females exposed to 16 kr during the pupal or adult stage and mated to untreated males produced no eggs. When males and females were treated with 16 kr as 1-, 5-, or 10-d-old adults and mated immediately after treatment, normal numbers of eggs were produced but very few adults emerged, except for females treated when 10 d old, which produced a significantly larger number of eggs than females treated at 1 and 5 d of age. When 1-, 5-, or 10-d old males were irradiated with 16 kr and mated 1 or 6 d after treatment to untreated females, normal numbers of eggs were produced, but again few or no adults emerged, an indication that restoration of damaged sperm did not occur. When males exposed to 8 or 16 kr were individually furnished a series of untreated virgin females within an 8-h period on the same day of treatment and 5 and 10 d after treatment, the females laid fairly normal numbers of eggs, but 99% of these eggs were sterile. Fewer eggs were deposited by the 4th and 5th untreated females in each series than by the 1st and 2nd females. (Auth.)

- 785 Hoenigsberg, H.F., Pozzi, L.V., Sironi, G.P. THE RESPONSE OF *Drosophila* TESTIS TO X-RAY INDUCTION OF DOMINANT LETHALS. *Atti. Ass. genet. ital.* 6 (1961) 261-76. (In English).

Data presented suggest 1) that to call a 3-d batch of sperm of *D. melanogaster* (as done in dosage-frequency experiments) an homogeneous sample is erroneous since it contains a mixture of sperm cells which "die" differently; 2) that a 9-d sensitivity spectrum includes all stages from mature spermatozoa to spermatocytes, whereas the highest sensitivity to x-rays is localized in the meiotic stage; and 3) that in the O_2 -effect 2 processes work independently from each other: one causing an increase in chromosome breaks, the other affecting the amount of rejoining of breaks.

- 786 Hoopingarner, R., Kumararaj, S., French, A. GAMETOGENESIS AND RADIATION RESPONSE IN THE CEREAL LEAF BEETLE. (Abstr. 293) *Bull. ent. Soc. Amer.* 9, 3 (1963) 175.

Gametogenesis in both male and female cereal leaf beetles, *Oulema melanopa* (L.), shows considerable meiotic activity in all stages of adult development. Feulgen-DNA stains were used to trace development. Beetles were subjected to x-rays to produce dominant lethal sterility.

- 787 Ives, P. T. GENETIC AND DIRECT EFFECTS OF GAMMA RADIATION ON Drosophila. (Abstr. B1D387) p. 46-7 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC, July 1963.
- During the year we completed work on the X-mutation rate- γ dose relationship after 1/4, 1/2 and 1 kr, testing daily sperm samples, days 1-12, at 25°C. The relationship is linear except that 1/4 kr gives the same rate as 1 kr and higher than 1/2 kr in days 9-10 sperm dropping to the linear level in days 11-12. Possibly germinal selection is delayed until day 11 at 1/4 kr. The control rate is constant for all days. — $\sigma\sigma$ raised and kept at 20° or 15° show peak mutation rates, after 1 kr, in sperm deposited as much later after irradiation as development was longer at those temperatures, proving that the level of mutation response is "stage specific" in spermatogenesis, not "time specific" after irradiation. There was variation by a factor of 2 between series of tests at 15°C. — Studies on induced chromosomal changes showed 35% lethality, probably position effect, associated with each translocation break, but none associated with crossovers, in $\sigma\sigma$. — Current studies are on (1) Variation in mutagenic response to radiation in 15° C-tests, (2) Lethality associated with induced autosomal inversions, and (3) Possible synchronized responses to radiation (simultaneous crossovers in chromosomes 2 and 3) in premeiotic spermatogenic stages.
- 788 Kaneko, A., Shima, T., Momma, E. DOMINANT LETHALS INDUCED IN DROSOPHILA VIRILIS THROUGH IRRADIATION OF GERM-CELLS. (Abstr.) Jap. J. Genet. 37 (1962) 392. (In Japanese).
- 789 Kansu, A. PRELIMINARY EXPERIMENTS ON THE STERILIZATION OF THE PUPAE OF THE KHAPRA BEETLE BY IRRADIATION WITH GAMMA RAYS. Z. angew. Ent. 49, 2 (1962) 224-8.
- Tests on the sterilization of Trogoderma granarium Everts, which has become a serious pest of stored grain in Turkey, were carried out by exposing the pupae to γ -rays from Ir^{192} . Doses of 6000 r or more reduced reproductive capacity when applied to 1-d-old male pupae, and 15 000 r, the highest dose applied, resulted in the sterilization of all the males in 2 out of 3 tests. Doses of up to 7500 r applied to female pupae had no effect on reproductive capacity. Further tests indicated that the effects become more apparent in the 2nd generation after irradiation. Following a dose of > 10 000 r, malformation (elytrae) was observed in some adults.
- 790 Laviolette, P., Nardon, P. INFLUENCE DE L'IRRADIATION SUR LES ADULTES DE SITOPHILUS SASAKII TAKAHASHI (CURCULIONIDAE) ET LEURS DESCENDANTS. p. 431-40 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963".
- Le rayonnement gamma de Co réduit significativement la moyenne de vie. Tous les insectes meurent en 12 j à 8000 r, en 4 j à 100 000 r. La mort apparaît brusquement après une phase de latence plus ou moins longue selon la dose, variant de 12 j (5000 r) à 1 j (100 000 r). L'étude du coefficient de variabilité et de la moyenne de survie en fonction de la dose suggère la présence de deux mécanismes sensibles détruits par l'irradiation. La stérilisation par les rayons X est plus efficace à 150 kV qu'à 80 kV. L'irradiation des parents a pour conséquence de diminuer la fertilité et le poids des descendants, et d'augmenter leur durée de développement. Ces effets se transmettent d'une génération à l'autre sans que l'expérimentateur procède à aucune sélection. Alors que les deux premiers tendent à disparaître, l'augmentation de la durée du développement reste stable pendant au moins 10 générations. (Voir 781).
- 791 Laviolette, P., Nardon, P. ACTION DES RAYONS γ DU COBALT 60 SUR LA MORTALITÉ ET LA FERTILITÉ DES ADULTES D'UN CHARANÇON DU RIZ. Bull. biol. 97 (1963) 305-33.
- Le rayonnement γ issu de la bombe au ^{60}Co réduit significativement la moyenne de vie des males de Sitophilus sasakii à partir de 5000 r, et celle des femelles à partir de 7000 r. A 8000 r, tous les insectes meurent en 12 j. Jusqu'à 6000 r, l'étude de la répartition de la mortalité dans le temps montre que l'irradiation fait apparaître progressivement une hétérogénéité dans la population, isolant des individus plus résistants. L'examen des courbes de survie révèle que la mort est toujours différée. Elle se déclenche brusquement après une période de latence plus ou moins longue selon la dose. L'étude de la variabilité montre que selon la dose, l'irradiation augmente ou diminue la sensibilité des insectes aux variations incontrôlables du milieu. La sensibilité au rayonnement semble augmenter avec l'âge. Dès 2000 r la fertilité se trouve réduite de moitié. A 5000 et 6000 r on observe une phase de stérilité temporaire. La stérilisation totale est acquise à 15 000 r. La fécondité est beaucoup moins résistante que la fertilité, puisque même à 18 000 r des œufs sont pondus. Il est possible d'envisager l'emploi des radiations pour la désinsectisation des denrées. (Aut.)

- 792 Lee, W.R. RELATION OF DOMINANT LETHALS TO DOSE IN THE HONEY BEE. (Abstr.) Genetics 48, 7 (1963) 897.

Variation in egg viability among individuals has made precise determinations of dominant lethal mutation rates difficult at rates less than 0.1. To overcome this difficulty a technique of partial-body irradiation was developed which made it possible to make all comparisons intra-queen. Six queens were paired into three groups, and frames of eggs from the two queens in a group were always paired and tested together for egg viability in the same colony. The viability ratio was taken as the ratio of the proportion of eggs hatching from queen "A" of each pair divided by the proportion of eggs hatching from queen "B" so as to correct for environmental variation. After these tests the spermathecae of "A" were irradiated with 260 r of 50 KVP x-ray and the viability tests repeated. 2000 gametes of each queen were tested in each test. The post-irradiation tests were conducted after the irradiated queen had laid eggs for one week; hence the eggs tested for viability had at the time of irradiation been oögonia in a well-shielded anterior region of the ovary. This procedure was repeated twice in order to give accumulated doses. After correcting each pair to make the pre-irradiation ratio unity, and then averaging the three pairs, the following proportions of dominant lethals (corrected for saturation effect) were found: 260 r, 0.08; 520 r, 0.26; and 780 r, 0.38. The dosage response curve varied as the 1.4 power of the dose, being significantly non-linear.

- 793 Lefevre, G., Jr., Jonsson, U.B. SPERM TRANSFER, STORAGE, DISPLACEMENT, AND UTILIZATION IN Drosophila melanogaster. Genetics 47, 12 (1962) 1719-36.

p.1727-8 describe an experiment on sperm displacement carried out with (5000 r x-irradiated) males. It showed that such sperm were not as effective in displacing sperm from the female storage organs as sperm from normal (wild type) males. It may well be that irradiation not only produced a high level of dominant lethality but some inactivation of the sperm as well.

- 794 Lindale, D.L. A MUTUAL SPARING EFFECT OF THE X AND Y CHROMOSOMES TO THE STERILIZING EFFECTS OF X-RAYS. (Abstr. B1A956) p.57-8 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

It appears that when both the X and the Y chromosomes are present in the same irradiated sperm they have some sparing action on each other. Three types of male sterility are observed in the sons of irradiated males: prespermatogenic, spermatogenic, and post-spermatogenic. In the present experiments > 800 males were dissected and scored microscopically for the type of sterility.

Spermatogenic sterility was the only class that showed an increase with dose and was by far the most frequent. It is characterized by a fairly normal testis distally with, however, a large region of necrotic tissue in the proximal part, and by empty seminal vesicles.

- 795 McDonald, D.J., Long, H.C. EFFECT OF NEUTRON IRRADIATION ON THE FERTILITY OF Tribolium confusum. Amer. Nat. 95 (1961) 124-6.

Preliminary experiments were carried out on adult males of T. confusum, which were exposed to a neutron dose of about 500×10^4 n/cm² or about 254 rads. Although subsequent matings indicated a significant difference in fertility between the irradiated and control males ($F=36.2$, $n_1=1$, $n_2=47$) there seems to be no significant change in fertility during those post-irradiation observation periods (6) for which matings and offspring were tested, i.e. there is no indication of a differential sensitivity of the male germ cells in T. confusum. These studies are being followed up.

- 796 McDonald, D.J. THE EFFECT OF NEUTRONS AND X-RAYS ON THE FERTILITY OF Tribolium confusum (Abstr.) Genetics 46, 8 (1961) 881.

The effect of 180 kV x-rays and fast neutrons with an average energy of about 4 MeV, on the fertility of males of the flour beetle T. confusum was investigated by mating each irradiated male with 10 successive females for 2-d periods and determining, in the x-ray experiments, the percent of viable eggs and in the neutron experiments, the number of offspring produced by the females over several days. 29.6% of the eggs produced by 120 females mated with 10 males receiving 2900 r of x-rays, developed into adults, compared to 39.9% for 10 males receiving 1450 r and 82.2% for ten unirradiated control males. Viability of eggs produced by females mated with x-rayed males 11 to 12 d after irradiation reached minimal values of 10.5% and 30.2% in the higher and lower dose experiments respectively, probably reflecting differences in the sensitivities of cells in various stages of spermatogenesis. Hatchability in the 2900 r experiments tested 55 d following irradiation of the males, had attained control levels, indicating the absence of any permanent

damage. — In the preliminary experiment with neutrons the mean number of off-spring produced by the females mated with irradiated males was 59.3 compared to 77.0 for the controls. No significant difference in the fertility of the males during the 12 d following irradiation was noted.

- 797 McDonald, D.J. X-IRRADIATION OF THE DEVELOPING MALE GERM CELLS OF Tribolium confusum. Genetics 46 (1961) 1511-7.

Young adult males of the flour beetle, T. confusum, have been shown to require about 4 d, following eclosion, to reach sexual maturity. Subjecting 2- or 3-d-old males to 1450 or 2900 r of x-rays depresses their fertility, as evidenced by the increase in the percentage of inviable eggs produced by their mates. This inviability, probably due in part to the induction of dominant lethals, reaches a maximum value 11 to 12 d following irradiation, and then declines. In general, the pattern of response suggests the various stages of spermatogenesis of T. confusum are differentially sensitive to x-rays. No evidence was found for recovery of irradiated sperm sored by females, or of extended effects on the fertility of the treated males. (Auth.)

- 798 Michigan State Univ., East Lansing, Mich. BASIC FERTILIZATION PHENOMENA AND GAMETIC LETHALITY IN Drosophila. Technical Progress Report. TID-15021. 1962. 4p.

The processes involved in normal insemination in D. melanogaster are being studied by dissection and observation of the genital tract of inseminated females at intervals following copulation. Movement of the spermatozoa into the ventral receptacle of the female did not seem to be accomplished by swimming action of the sperm, but groups of longitudinally-oriented sperm appeared to be drawn en masse into the ventral receptacle. Definite mating preferences of males and females correlated with strain were noted. Observations of females irradiated after insemination supported the hypothesis that irradiation produces a lethal, rather than merely deleterious, effect on the mature sperm cells. Differential survival of gametes was examined by two genetic techniques. Data from both of the experiments agreed in suggesting an apparent enhancement of radiation damage in stored sperm. (NSA 16:1962, 9845)

- 799 Mortimer, R.K., Borstel, R.C. von. RADIATION-INDUCED DOMINANT LETHALITY IN HAPLOID AND DIPLOID SPERM OF THE WASP Mormoniella. Genetics 48, 11 (1963) 1545-9.

A doubling of the chromosome complement on Mormoniella sperm from haploid to diploid doubles the sensitivity to radiation when dominant lethality is the criterion. X-rays were used.

- 800 Oftedal, P. INDUCTION OF MUTATIONS AND CELL KILLING IN IRRADIATED Drosophila SPERMATOGONIA. (Abstr. 5.43) p.69-70 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

Treatments of Drosophila spermatogonia with acute doses of 55 r, 110 r, 160 r and 310 r gave a clearly non-linear dose-effect curve for sex-linked recessive lethals. In order to explain the results, a mathematical model for the irradiated cell population has been formulated, considering cell killing, variation in sensitivity to killing and to mutation induction with cell cycle stage, and length of cell cycle. Thus, the frequency of mutations observed will be equal to the product of: dose absorbed by sensitive cells x number of sensitive cells x sensitivity of sensitive cells x survival of sensitive cells, divided by: total number of cells in population less killed sensitive cells. In this first approximation, effects on resistant cells have been disregarded. According to this model, protraction of doses in this dose range should lead to higher yields of mutants. Protraction of 144 r, 287 r, and 542 r over 8 h (4 spermatogonial cell cycles in the irradiated embryo), have given results in support of the hypothetical model, showing a linear increase in mutation rate with dose, with a slope higher than 2×10^{-5} sex-linked lethals per r, indicating a sensitivity at least as high as for mature sperm, for doses lower than a few hundred r.

- 801 Oftedal, P. GENETIC SENSITIVITY AND DIFFERENTIAL KILLING IN IRRADIATED Drosophila SPERMATOGONIA. (Abstr.) Int. J. Rad. Biol. 6, 5 (1963) 490.

Irradiation of Drosophila spermatogonia in 20 ± 3-h-old eggs/larvae with doses of 0 r, 56 r, 109 r, 163 r and 307 r, at 25 r/min, have resulted in sex-linked recessive-lethal frequencies indicating a non-linear dose-effect relationship with reduced effects at the higher doses. It was hypothesized that the spermatogonia constitute a cell-population heterogeneous as regards sensitivity both to mutation-induction and to cell-killing. In a population of N spermatogonia, a dose D would then lead to the observable genetic effect

$$E_{\text{obs}} = \frac{D \sum_{k=1}^N n_N (1 - k_N)}{\sum_{k=1}^N n_N (1 - k_N)}$$

If the sensitivity to mutation-induction n_N is correlated with the survival function $(1 - k_N)$, this expression leads to non-linear dose-effect curves. These can be fitted to the experimental results if assumptions are made about the relative frequency of sensitive cells in the population, and about the shape of the survival-curve. This formulation of the hypothesis also leads to the prediction that protraction of the doses over several cell-cycles should lead to higher yields of mutations, since sub-killing damage should be repaired for each cell-generation, in accordance with Elkind's observations. This prediction has been tested by giving similar doses over 8 h, which cover 3-4 cell-cycles. The results show a significantly higher effect at the 300 r level and a reasonable quantitative agreement with the predictions.

- 802 Ofstedal, P. INDUCTION OF MUTATIONS AND KILLING OF CELLS IN IRRADIATED SPERMATOGONIA OF Drosophila. Nature, Lond. 199 (1963) 1301-2.

If a given dose were protracted over several cell generations, the observable genetic damage should be higher than that found after acute treatments. This hypothesis was tested with doses of 144 r and 267 r, as against 8-h-irradiations of spermatogonia at 25 r/min. The results seem to support the idea of differential killing as an explanation. The effect is similar to that found by Tazima et al. (1143) after irradiation of silkworm larvae, 3-10 d old, and opposite that found after treatment of earlier stages. The results are not in agreement with those reported by numerous other workers.

- 803 Parfenov, G.P. APPEARANCE OF DOMINANT LETHAL MUTATIONS IN Drosophila melanogaster DURING COSMIC FLIGHT ON SHIP-SATELLITE. p. 324-9 in FTD-MT-62-78, n.d. Translation.

A significant increase in frequencies of dominant lethal mutations in spermatides of male D. melanogaster occurred during a satellite flight. Data indicate that the increase was the result of rocket vibrations rather than radiation dose. (From NSA 17: 1963, 35280).

- 804 Peleerents, C. QUELQUES RESULTATS SUPPLEMENTAIRES CONCERNANT L'INFLUENCE DES RAYONS GAMMA SUR LES CHRYSALIDES ET LES ŒUFS DE LA TEIGNE DE LA FARINE "EPHESTIA KUEHNIELLA Z." Rev. Agric. 16, 2(1963) 305-20.

En irradiant des chrysalides adultes (15 j) avec 600 00 rad, il est possible d'obtenir des mâles stériles et agressifs. Par contre, à l'âge de 3 j les rayons occasionnent un ratatinement des ailes, le pourcentage d'éclosion et la durée de vie sont fortement réduits et la tendance à l'accouplement a complètement disparu. L'influence des rayons γ (500-2500 rad) sur embryons est fonction de l'âge de embryons. Les individus ne réagissent pas de la même façon à une dose identique. Les influences sur la fertilité sont héréditaires, la fertilité étant très probablement tributaire de plusieurs gènes. Les spermatogonies sont plus sensibles aux mutations que les oögonies. Les moyennes d'éclosion des papillons F_1 sont plus élevées dans les croisements entre teignes normales et irradiées qu'en endogamie. L'on trouve chez les femelles irradiées au stade embryonnaire 2 sortes de stérilité: l'effet d'une dose de 7000 rad est plus prononcé chez les embryons de 4 j (pas d'œufs) que sur les embryons de 6 j (présence d'œufs mais absence d'éclosion). Au point de vue pratique, il est plus facile de rassembler et de traiter des œufs que des chrysalides. Les essais ont prouvé la possibilité d'induire chez les chrysalides et chez les embryons des mutations (du type dominant dans le cas de la teigne) qui provoquent un certain degré de stérilité.

- 105 Pendlebury, J.B., Jefferies, D.J., Banham, E.J., Bull, J.O. SOME EFFECTS OF GAMMA RADIATION ON THE LESSER GRAIN BORER (Rhizopertha dominica F.), TROPICAL WAREHOUSE MOTH (Cadra (Ephestia) cautella Wlk.), INDIAN MEAL MOTH (Plodia interpunctella Hübn.), AND THE CIGARETTE BEETLE (Lasioderma serricorne F.). AERE-R-4003, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1962. 23p.

Various effects of γ -radiation on 4 stored products pests, which infest grain and cereal products in varying degrees, were examined with particular emphasis on susceptibility to radiation sterilization. R. DOMINICA, described as the most destructive pest of grain, and L. serricorne, occasionally found infesting cereal products, are effectively sterilized by the dose (16 000 rads) evaluated for the control of large populations of grain weevil. C. cautella and P. interpunctella, principally pests of dried fruits, but occasionally imported on infested cereals, are more resistant to radiation sterilization. 16 000 rads is unlikely to be completely effective for their control. (Auth.)

- 806 Pearson, P., Vernier, J.M. LA PROTECTION DES DÉRIVES CONTRE LES INSECTES RAVAGEURS PAR L'EMPLOI DES RADIATIONS IONISANTES EN VUE D'OBTENIR LA STÉRILITÉ DES INSECTES ADULTES. ÉTUDE PARTICULIÈRE DE LA RÉACTION DES GONADES DE "*Stophilus granarius*". Ann. Nutr., Paris, 17, 6 (1963) B-487-B497.
- Divers stades de développement de certains coléoptères infestant des céréales, en particulier, *S. granarius*, ont été étudiés par l'emploi des radiations ($\gamma^{60}\text{Co}$, 1000-20 000 rads). La radiosensibilité se montre supérieure chez les mâles où les létales et les doses stérilisantes sont voisines. Les auteurs considèrent quelques modifications histologiques et cytologiques de l'appareil sexuel dues aux radiations ionisantes.
- 807 Proverbs, M.D., Newton, J.R. SOME EFFECTS OF GAMMA RADIATION ON THE REPRODUCTIVE POTENTIAL OF THE CODLING MOTH, *Carpocapsa pomonella* (L.) (LEPIDOPTERA: OLETHREUTIDAE). Canad. Ent. 94, 11 (1962) 1162-70.
- The reproductive potential of the codling moth, *Carpocapsa pomonella*, was reduced about 75% when 50 γ -irradiated male moths (exposed as mature pupae to 30 000 and 40 000 rads) were caged in the laboratory with 5 normal male and 5 normal female moths. The reduction in reproductive potential was less marked when both 50 irradiated (30 000 rads) males and 50 irradiated (30 000 rads) females were added to the normal insects. Eighty-nine to 99% of the mature larval offspring of irradiated (30 000 rads) male \times normal female moths were males; the male offspring were largely sterile and the female offspring completely so. Sperm from irradiated (40 000 rads) male moths were less competitive than those from normal males. (Auth. summary).
- 808 Proverbs, M.D., Newton, J.R. SUPPRESSION OF THE REPRODUCTIVE POTENTIAL OF THE CODLING MOTH BY GAMMA IRRADIATED MALES IN CAGED ORCHARD TREES. J. econ. Ent. 55, 6 (1962) 934-6.
- Fully developed pupae of the codling moth, *Carpocapsa pomonella* (L.), were exposed to 40 000 rads of γ -radiation and the emerged adults caged with normal moths over dwarf apple trees. The average numbers of mature larval offspring per cage that developed when each cage was supplied with (a) 5 normal male, 5 normal female, and 50 irradiated male moths, (b) 5 normal male, 5 normal female, 50 irradiated male, and 50 irradiated female moths, or (c) 5 normal male, 5 normal female, and no irradiated moths were: 6.0 in (a), 18.6 in (b), and 40.3 in (c). In another experiment, in which the number of normal moths remained the same but the number of irradiated moths of each sex was increased from 50 to 100, the average numbers of mature larvae that developed in each cage were 0.7, 2.0, and 33.3, respectively. (Auth.)
- 809 Proverbs, M.D. STERILIZATION OF THE CODLING MOTH BY GAMMA-IRRADIATION. Nature, Lond. 194, 4835 (1962) 1297.
- When male pupae, within 1 d of adult emergence, were exposed to 40 000 r of γ -rays (Co^{60} -source) dominant lethals were induced in about 99% (sperm) without affecting adult emergence, mating or adult longevity. Similar effects followed irradiation of 12-24 h old male moths. Further tests on radiosensitivity of different stages are reported. Experiments on matings amongst different sets and ratios of irradiated or control adults are described under laboratory and some under orchard (cage tests) conditions. Results indicate that the sterile male technique may be a promising method for the control of the codling moth, *Carpocapsa* (= *Cydia*) *pomonella* (L.)
- 810 Расулов, Ф.К. ВЛИЯНИЕ ГАММА-ЛУЧЕЙ НА СТЕРИЛЬНОСТЬ КАРАДРИНЫ. Хлопководство 7 (1963) 41-2.
- Rasulov, F.K. ACTION DES RAYONS γ SUR LA STÉRILITÉ D'UNE NOCTUELLE DU COTON (GENRE *Laphygma exigua*). Khlopkovodstvo 7 (1963) 41-2.
- The moth, *Spodoptera exigua*, is a cotton pest. Eggs, larvae and pupae were subjected to γ -radiation from a Co^{60} -source at 26 r/sec (total dose 3000-11 000 r), at 25-27°C and a humidity of 65-75%. Irradiation with 3000 to 5000 r does not prevent larval development and does not inhibit larvae breeding. Exposure to 7000, 9000, 10 000 and 11 000 r permitted only a small number of larvae to reach maturity. Irradiation of male and female cocoons with 3000 r resulted in 36.8% sterility in males, at 5000 r-46%, 7000 r-45%, and 10 000 to 11 000 r-100%. Complete sterility was evident in females following exposure to 5000 r. Total sterilization of males and females was obtained with a dose of 9000-11 000 r. The life spans of mature moths from irradiated male cocoons was 4-5 d; for non-irradiated, 5-6 d.

- 811 Rhode, R.H., Eglosa, F., Lopez, D.F., Telich, D.J. EFFECT OF GAMMA RADIATION ON THE RE-PRODUCTIVE POTENTIAL OF THE MEXICAN FRUIT FLY. J. econ. Ent. 54, 1 (1961) 202-3.
- Preliminary experiments are described on radiosensitivity of pupae. Adults of both sexes were rendered sterile when 12 d-old pupae were exposed to 5000 r. Longevity appeared normal, and neither aggressivity nor mating behaviour of young males was affected. Rate sensitivity was also investigated and results tabulated for 90 r, 70 r, 50 r, 30 r and 10 r/min. In tests with caged fly populations the almost total eradication at the 50: 1 overflooding rate was of unusual interest.
- 812 Sacca, G. ESPERIENZE CON MOSCHE DOMESTICHE, STERILIZZATE CON RAGGI X. (Study on houseflies, sterilized with x-rays). Atti Accad. naz. Ital. Ent., Rend. 8 (1961) 91-8. (In Italian, with English summary).
- Experiments were conducted on radiosterilization of male houseflies. The females of *Musca domestica* are monogamous, so that all the females mating with sterile males lay sterile eggs. Tests with 24-kV x-rays showed that the most satisfactory method of sterilizing male houseflies consists of irradiating the pupa with 3000 r 2 to 3 d before emergence. The mortality of the irradiated pupae was not appreciably increased and the flies emerging from them were normal in appearance, viability, longevity, and sexual activity. When the irradiated males were mated with normal females, sterility was 100% complete. However, there was a slight tendency for females mated with irradiated males to remate with normal males. Sterile males successfully competed with normal males in search of females, and when they were present in overwhelming numbers succeeded in mating with most of the females, leaving them sterile. (From auth. summary). Also published in Rend. Ist. Super. Sanita 24 (1961) 5-12.
- 813 Takeda, H., Tanaka, K. STUDY OF THE INFLUENCE OF X-RAYS UPON THE HEMOCYTES OF THE SILKWORM LARVAE *Bombyx mori*, L. (Abstr.) p.358 in "The 5th Japan Conference on Radioisotopes 21-23 May 1963". Tokyo, Japan Atomic Industrial Forum Inc.
- An attempt was made to investigate damaging effects of x-rays (2000 r) on the number of blood cells of silkworm larvae on the 2nd day of the 5th instar. A marked decrease in haemocyte counts was observed. The extent of this drop is not connected with the sex of the larvae.
- 814 Tazima, Y., Onimaru, K. STUDIES ON THE GENETIC EFFECT OF RADIATION 1959-1960. II. STUDIES ON THE GENETIC EFFECT OF RADIATION WITH SILKWORM. (1) DIFFERENCES BETWEEN TIMES OF DEATH OF THE F_1 AFTER IRRADIATION OF OÖGONIA OR MATURE OÖCYTES. Nucl. Sci. Abstr., Japan 1, 3/4 (1962) 117-8. (In English).
- Marked differences in radiation-induced mutation rates for different stages of gametogenesis have been observed in the silkworm, both for visible recessive mutations and dominant lethals. Maximum mutation incidence is observed in spermatids and mature oöcytes. In mature oöcytes the observed mutation rate is several times as high as in oögonia. By the specific locus methods with egg colour mutants it was found that induction rates rise linearly with increasing radiation doses applied to oögonia; with mature oöcytes, however, they increase rapidly with doses of power > 1. This suggests that most of the mutants induced in oögonia may be accompanied by gross chromosomal aberrations, aberration-bearing cells being eliminated subsequently in the long course of gametogenesis. Mortality was measured at various developmental stages of the F_1 from irradiated oögonia and irradiated mature oöcytes. 1000 r of Co^{60} γ -rays were given. A considerable percentage of the F_1 individuals from irradiated mature oöcytes were found to be eliminated during the embryonic and larval stages, especially in the earlier stages.
- 815 Thomou, H. STERILIZATION OF *Dacus oleae* BY GAMMA RADIATION. p.413-24 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency, 1963.
- Three developmental stages of the olive fly were exposed to γ -radiation from a Co^{60} source and the sterilization dose determined. For 4th-instar larvae the sterilizing dose was 2000 ± 300 rad, for pupae 11 000-15 000 rad and for adults 15 000-18 000 rad. Mating studies showed that sterility persisted throughout the life of the adults. The effect of dose on emergence was studied with 4th-instar larvae and pupae. The larvae were exposed to 300-3000 rad at 300-rad intervals, while the pupae were exposed to 3000-15 000 rad at 3000-rad increments. Maximum emergence was obtained when 8-d-old pupae were irradiated. Significant fluctuations occurred at all dose-rates. (From auth.)

- 816 Ulrich, H. X-RAY INDUCED "DOMINANT LETHALS" IN INSEMINATED EGGS OF *Drosophila*. (a) EXPERIMENTS IN THE STAGE BETWEEN COMPLETION OF MEIOSIS AND BEGINNING OF CLEAVAGE. (Abstr. 5.47) p.71 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

In insects, pre-adult mortality of the progeny of irradiated parents is thought to result from radiation induced "dominant lethals" in the genome of the maternal or paternal gametes. These "dominant lethals" can be either gene or chromosome mutations. Similar radiation effects (e.g. embryonic mortality) are found if instead of the gametes the progeny (e.g. young embryos) is irradiated. This raises the question whether in both types of experiments pre-adult mortality is the result of "dominant lethals" (i.e. alterations in the genome) and/or "physiological effects" (i.e. effects in cell components other than chromosomes). During the last 10 years we have accumulated quite a number of experimental results on inseminated *Drosophila* eggs, x-rayed after deposition in the stage between completion of meiosis and beginning of first cleavage. Most data (e.g. differential radiosensitivity of cell parts with or without a nucleus, the one hit dose action curves for mortality and recessive lethals, influence of oxygen during irradiation, etc.) were consistent with the assumption that the most important radiation effects are alterations in the genome which behave like dominant lethals (probably of a one hit type predominantly). However, new results (experiments with cold post treatment and the analysis of radiosensitivity of eggs and embryos with different chromosomal constitutions) indicate that at least some of the radiation effects have to be considered as "physiological effects".

- 817 Walker, J.R. EVALUATION OF CONTROL OF EUROPEAN CORN BORER, *Ostrinia nubilalis* (Hübner), BY X-RAY INDUCED STERILITY. Diss. Abstr. 23 (1962) 761.

Records on emergence from 4 groups of untreated European corn borer larvae, involving 11 560 individuals, showed that on the 1st day of emergence 50% of the moths were females. After the 1st day of emergence, males outnumbered females with a gradual shift to more females during the latter part of the emergence period. The sex ratio of the moths studied was approximately 57% males and 43% females. Mating studies indicated that corn borer moths had a poor to moderate fecundity level. In cages containing eight males and eight females only 87.7% of the females mated. Also only 58-88% of the eggs deposited by females in the control matings hatched. Exposure of 1-d-old male moths to 32 000 r resulted in 1% egg hatch when they were mated to untreated females. The irradiated males competed equally with untreated males for virgin females. A ratio of 8 irradiated males to 4 untreated males to 8 untreated females resulted in 39.4% hatch of the deposited eggs. The survival of the irradiated males compared favourably with untreated males under laboratory conditions. Exposure of pupae to x-rays resulted in a reduction in the percent of egg hatch as the dose was increased. Female pupae were more susceptible to the effects of irradiation than male pupae. The percent of egg hatch varied with the age of the pupae at the time of treatment, younger pupae being more susceptible to irradiation than older pupae. (Auth.)

- 818 Walker, J.R., Brindley, T. A. EFFECT OF X-RAY EXPOSURE ON THE EUROPEAN CORN BORER. J. econ. Ent. 56, 4 (1963) 522-5.

When untreated virgin females were mated to male moths of the European corn borer (*Ostrinia nubilalis* (Hübner)) treated 1 d after emergence with 32 000 r of x-rays, only 1% of eggs hatched. Irradiated males competed equally with the untreated males for females. Moths caged together at a ratio of 8 irradiated males to 4 untreated males to 8 untreated females resulted in 39.4% hatch of eggs. Survival of the irradiated males compared favourably with that of untreated males under laboratory conditions. Exposure of pupae of both sexes to x-rays resulted in a reduction in % egg hatch as the dose was increased. Female pupae were more susceptible to irradiation than males. The % egg hatch varied with age of pupae at treatment, younger pupae being more susceptible to irradiation than older pupae. (Auth.)

- 819 Whiting, P.W. R-LOCUS FACTOR HOMOLOGIES IN *Mormoniella*. Genetics 47, 7 (1962) 921-36.

In the wasp *Mormoniella*, the complex locus, R, after irradiation-induced mutations, frequently contains deleterious factors, — lethals, male steriles, or female steriles. Only the last can be transmitted by haploid males and, therefore, homologies of lethals or of male steriles must be determined by use of diploid males, a mutant type aberrant for these insects. Normal diploid females heterozygous for one mutant lethal are crossed to diploid males heterozygous for another. Sperm of diploid males are diploid and hence triploid females are sired, one-half of which carry a lethal from each parent, one-half, the paternal lethal only. By use of proper eye colour tags, diploid F_2 males carrying two different lethals can be identified. Any theoretically expected type of eye colour in diploid males not found, indicates homology of the lethals, such males being inviable. Among 53 tests of 31 genes bearing lethals (or male

steriles) only one combination proved inviable. The fact that most deleterious changes caused by mutation are non-homologous, affecting different vital processes, indicates great complexity of this single locus, R. "Self-tests" were made by the same method as used for tests of lethals from separate mutations. As expected, the diploid males homozygous for the same lethal were in no case viable. Comparisons are discussed between the R locus of *Mormoniella* and the "super-genes" of polymorphic species as also the induced complex genes of *Drosophila* and microorganisms. (Auth.) BA: 41: 1963, 8790.

- 820 Würzler, F.E. X-RAY INDUCED "DOMINANT LETHALS" IN INSEMINATED EGGS OF *Drosophila*. (b) EXPERIMENTS WITH DIFFERENT STAGES BETWEEN INSEMINATION AND END OF SECOND CLEAVAGE DIVISION. (Abstr. 5.48). p. 71-2 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963, Vol.1". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

The nature of x-ray induced mortality in inseminated *Drosophila* eggs has been studied by analysing the radiosensitivity in different stages of meiosis and early cleavage. The highest sensitivity was found during late anaphase/early telophase of meiosis II and each cleavage division analysed so far. Sensitivity was lowest when the nuclei were in interphase. Dose action curves for the different stages vary greatly in shape and slope. The one hit curve found for egg samples containing all stages between completion of meiosis and beginning of cleavage (see 816) could be shown to result from superposition of different non linear dose effect curves. This result invalidates the strongest argument supporting the hypothesis that radiation induced mortality is of a one hit type. It has been shown by various authors that insect embryos developing from irradiated gametes can die at different stages of development. In *Habrobracon* and *Drosophila* different lethal syndromes seem to result from different kinds of nuclear damage as shown by Von Borstel (1961). Different lethal syndromes can also be distinguished after irradiation of inseminated *Drosophila* eggs. The dependence of the relative frequencies of different syndromes after irradiation in specific stages of nuclear divisions and the dose dependence of the different syndromes have been recorded. The results indicate that radiation induced genetic effects alone can hardly explain all the facts.

- 821 Virkki, N. GAMETOGENESIS IN THE SUGARCANE BORER MOTH *Diatraea saccharalis* (F.) (CRAMBIDAE). J. Agric. Univ. P.R. 47, 2 (1963) 102-37. (In English, with Spanish summary).

The gametogenesis of the moth was studied cytologically, in order to gain general information on the plausibility and means of obtaining sterile males by irradiation. The following stages require to be irradiated: - to affect spermatogonia and early spermatocytes: 7-10 d old larvae; to affect all stages of spermatogenesis; larvae > 15 d old; to affect spermiotogenesis: pupae.

See also:

- 854 The action of radiation and other mutagenic agents (1) in inducing mutation in *Drosophila* females, and (2) in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, 1961)
- 855 The action of radiation and other mutagenic agents (1) in inducing mutation in *Drosophila* females, and (2) in controlling the action of specific genes responsible for suppressing uncontrolled growth. Report Covering 9-Year Period, May 1, 1953-April 30, 1962.
- 878 Mutations in the screw-worm fly. (LaChance and Hopkins, 1962)
- 465 Inhibited oviposition by females of *Gryllus assimilis* (F.) induced by radioactive males, using L-methionine-methyl-¹⁴C. (Abdel-Malek, 1961)
- 467 Inhibitory effect of L-methionine-methyl-¹⁴C on oviposition by females of the cotton leaf worm, *Prodenia litura* (F.), induced by radioactive males. (Abdel-Malek, 1963)
- 470 Effects of ingested Pu²³⁹ on fecundity, fertility and life span of *Habrobracon* (Hymenoptera: braconidae). (Erdman, 1962)
- 472 The genetic and developmental effects of ingested radioactives in *Habrobracon*. (Grosch, 1960)
- 476 Certain biological effects produced in the boll weevil by tagging it with P³². (Mayer and Brazzel, 1961)
- 881 Radiation induced viability mutations in the honey bee. (Lee, 1963)
- 912 X-ray induced visible mutations in *Habrobracon* oocytes. (Whiting, 1963)
- 961 X-autosomal translocations of *Drosophila melanogaster*. (Watters, 1963)
- 991 Contrasts in radiation-induced mutation rates at different meiotic stages. (Whiting, 1962)
- 1000 Mutagenic sensitivity of sperm, spermatids, spermatocytes, and spermatogonia in *Drosophila melanogaster*. (Chandley and Bateman, 1961)
- 1002 Effects of x-ray irradiation in *Drosophila virilis* at different stages of spermatogenesis. (Clayton, 1962)
- 1016 Spermatogenesis of the silkworm and its bearing on the radiation induced sterility. (Sado, 1961)

- 1024 Considerations on the changes in observed mutation rates in the silkworm after irradiation of various stages of gametogenesis. (Tazima, 1961)
- 1028 Synaptic modification of dominant lethal frequencies after irradiation of the Drosophila testis. (Thompson, 1962)
- 1036 The relationship of radiations and environmental changes in oxygen concentration for biological damage in the immature germ cells of Drosophila virilis. (Alexander, 1968)
- 1037 The effects of radiation on the genetic system of organisms in relation to their physiological and biochemical systems. Progress Report, May 1, 1957-April 30, 1968. (Alexander, 1968)
- 1038 Biological damage in the mature sperm of Drosophila virilis in oxygen and nitrogen with different dose intensities of gamma rays. (Alexander and Bergendahl, 1962)
- 1040 The response of pre-meiotic and post-meiotic germ cells of Drosophila to dose fractionation and changes in partial pressures of gases. (Alexander, 1962)
- 1045 Influence of aeration during gamma irradiation of screw-worm pupae. (Baumhover, 1963)
- 1048 Alteration of mutation frequency by treatment with acrinomycin D. (Burdette, 1961)
- 1049 The effects of nitric oxide on radiation damage in Drosophila virilis and Drosophila melanogaster. (Cappe, 1961)
- 1053 Further observations on the relation between gas pressure and the x-ray damage in Drosophila melanogaster. (Chang, 1962)
- 1068 Studies on the genetic effect of radiation with silkworm. (Japan. National Inst. of Genetics, Mishima, 1963).
- 1075 Enhancement of radiation-induced sterility in insects by pretreatment in CO₂ + air. (La Chance, 1963)
- 1080 The effect of culture environment on the susceptibility of the grain weevil Sitophilus granarius L. to gamma radiation. (Martin, et al., 1962)
- 1082 Tolerance of gonial cells of Drosophila melanogaster for heavy X-ray doses divided into installments. (Meyer, et al., 1958)
- 1092 Effects of variable dose-rates on radiation damage in the rust-red flour beetle, Tribolium castaneum Herbst. (Nair and Subramanyam, 1963)
- 1103 The influence of temperature upon the radiation susceptibility of Sitophilus granarius L. (Pendlebury et al., 1962)
- 1104 Pathogenic effect of low and medium doses of gamma-rays on the progeny of irradiated insects. (Podolyan, 1963)
- 1116 Some effects of nitric oxide and oxygen on dominant lethal production in x-irradiated Drosophila virilis males. (Rinehart, 1962)
- 1117 Some effects of nitric oxide and oxygen on dominant lethal production in x-irradiated Drosophila virilis males. (Rinehart, 1963)
- 1123 The effect of carbon monoxide as a respiratory inhibitor on the production of dominant lethal mutations by x-rays in Drosophila. (Schmid, 1961)
- 1137 Effect of 2,4-dinitrophenol on irradiation-induced dominant lethal factors in Drosophila melanogaster. (Steger, 1962)
- 1144 Dose-rate dependence of radiation-induced mutation rates and selective killing. (Tazima and Kondo, 1961)
- 1145 Further studies on two types of dose-rate dependence of radiation-induced mutation rates in spermatogonia and oögonia of the silkworm. (Tazima and Kondo, 1962)
- 1159 The effect of temperature during irradiation on the brood-pattern of dominant lethals induced in Drosophila melanogaster sperm. (Wedvik and Strömmeas, 1963)
- 1169 The effects of gamma radiation and apholate on the reproductive tissues of Drosophila melanogaster Meigen. (Cantwell and Hemebery, 1963)
- 1173 Cytogenetic investigations on the nature of dominant lethals induced in meiotic oöcytes by gamma radiation and alkylating agents. (LaChance and Riemann, 1963)
- 1175 Mutational response of Habrobracon oöcytes in metaphase and prophase to ethyl methanesulfonate and nitrogen mustard. (Löbbecke and Borstel, 1962)
- 1180 Preliminary observations on chemosterilization of mosquitoes. (Weidhaas et al., 1961)
- 1198 The effect of x-radiation on the spermatogenesis of Petrobius maritimus. (Mathur, 1961)
- 1213 A comparative assessment of the injurious effect of ionizing radiation on heredity in mouse and Drosophila. (Shapiro et al., 1963)
- 1214 Preliminary studies on the effect of x-ray on Tribolium imagoes. (Sokoloff, 1961)
- 1215 Irradiation experiments with Tribolium. (Sokoloff, 1961)
- 1222 Effects of radiations on insects. (La Chance, 1962)
- 1227 Effects of gamma radiation on various stages of three fruit fly species. (Balock et al., 1963)

- 1228 The susceptibility of the confused flour beetle (Tribolium confusum Duv.) to gamma radiation. (Banham, 1962)
- 1237 Control of the Mediterranean flour moth Anagasta kuehniella Zell by sterile male release. II. Susceptibility to gamma radiation. (Bull and Wood, 1963)
- 1247 Comparative x-ray sensitivity of Tribolium confusum and T. castaneum (Coleoptera: Tenebrionidae) at different developmental stages during their lifecycle. (Erdman, 1962)
- 1256 Effects of 300 kV x-ray radiation on Sitophilus oryzae. (Hoover et al., 1963)
- 1263 Radiosensitivity of the various stages of oögenesis in Callitroga hominivorax. (LaChance, 1961)
- 1264 Radiosensitivity of developing reproductive cells in female Cochliomyia hominivorax. (LaChance and Leverich, 1962).
- 1276 Studies on the biological influence of the termites exposed to Co⁶⁰ gamma source. I. Influences on the adult of Formosan termite and its offspring. (Nakajima et al., 1963)
- 1281 Invloed van Gammastralen op eities van Ephestia kuehniella Zell. (The effect of γ -rays on eggs of Ephestia kuehniella Zell). (Peeters and Brande, 1961)
- 1284 Influence of gamma radiation on the development and fertility of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962)
- 1285 Radiosensitivity of various stages of Callosobruchus chinensis L. (Quraishi and Metin, 1963)
- 1287 Fecundity studies on x-rayed Mormoniella vitripennis. (Ray, 1963)
- 1290 Investigations on the spermatogenesis and embryonic development following irradiation of Calliphora erythrocephala Meig., Diptera, Calliph. males.) (Taage, 1963)
- 1297 Effects of desiccation of Drosophila females on the frequencies of irradiation induced embryonic abnormalities. (Annan and Reitan, 1961).
- 1310 Changes in quantitative traits under selection and irradiation. (Bardetx, 1963)
- 1322 Effect of ionizing radiation on Sitona weevils. (Ailmdzhanov and Khakimova, 1962)
- 1327 The effect of gamma radiation on the viability and fertility of Lucilia sericata Mg (Dipt.) irradiated as pupae. (Donnelly, 1960).
- 1330 The influence of X-rays on longevity, fecundity and fertility of Drosophila melanogaster. (Nöthel, 1963)
- 1351 The influence of x-rays on the vitality of Drosophila melanogaster. Studies of mortality, fecundity, and fertility after various doses. (Nöthel, 1963)
- 1354 Some early effects of ionizing radiation on the German cockroach, Blattella germanica. (Ross and Cochran, 1963)
- 1363 The effects of continuous and fractionated doses of gamma-radiation on the survival and fertility of Sitophilus granarius (Calandra granaria L.). (Jefferies, 1962)
- 1364 The effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (Calandra granaria) L. (Jefferies and Banham, 1961)
- 1371 Resistance of Sitophilus granarius and Sitophilus oryza at different stages of their development to γ -irradiation from cobalt-60. (Bruel and Bollaerts, 1960)
- 1372 X-ray effects on single and mixed species populations of Tribolium confusum and Tribolium castaneum (Coleoptera: Tenebrionida). (Erdman, 1962)
- 1373 The differential sensitivity of flour beetles, Tribolium confusum and T. castaneum to x-ray alteration of reproductive abilities, induced dominant lethals, biomass, and survival. (Erdman, 1963)
- 1375 The importance of competitiveness of radiosterilized males in mosquito-control programmes. (Dame and Schmidt, 1962)
- 1382 The effects of gamma radiation on the biology and behaviour of forest insects and the possibility of their control by means of irradiation techniques. (Stark, 1963)
- 1383 Some components of adaptive values of heterozygous Drosophila willistoni from irradiated natural populations. (Marques and Maciel, 1961)
- 1409 Further data on overdominance. (Wallace, 1963)
- 1410 Further data on the overdominance of induced mutations. (Wallace, 1963)
- 1414 Effects of radiation on ecological systems. (Erdman, 1963)
- 1427 Effects of ionizing radiation on insects and other arthropods. (Stone, 1963)
- 1436 Research on radiation in insect control. (Weidhaas et al., 1962)
- 1443 Cobalt-60 sterilization studies with Aedes aegypti (L.). (McCray et al., 1961)
- 1447 Laboratory studies on the use of irradiated sterile males to reduce C. fatigans Wied. populations. (Ramakrishnan et al., 1962)
- 1450 An experiment in the field with irradiated male Musca domestica in a rural zone in the Province of Latium. (Rivosecchi, 1962)
- 1453 The application of nuclear energy to agriculture. A Supplementary Report. (Moh, 1962)
- 1454 The application of nuclear energy to agriculture in Latin America. (Moh, 1963)

- 1455 Sterilization of the Mediterranean fruit fly and its application to fly eradication. (Katiyar and Valerio, 1963)
- 1458 The application of nuclear energy to agriculture. (Moh, 1963)
- 1460 Investigations on the sterilization of pernicious insects with ionizing radiations. (Baccetti and Cappellini, 1961)
- 1462 Possible use of ionizing radiations against the pine moth. (Baccetti and Zocchi, 1962)
- 1464 Could this be death to the codling moth? (Proverbs and Newton, 1961)
- 1485 Effect of gamma rays on insects. Progress on the use of induced sexual sterility for the control of the codling moth, *Carpocapsa pomonella* (L.) (Lepidoptera: Olethreutidae). (Proverbs, 1961)
- 1466 Control of the codling moth, *Carpocapsa pomonella* (L.) by the release of sexually sterile males. (Proverbs, 1963)
- 1468 Quelques effets des rayons gamma sur la teigne de la farine et sur divers nématodes. (Brande and Pelereux, 1962)
- 1489 Control of the Mediterranean flour moth *Anagasta kuhniella* Zell. by sterile male release. I. Biological studies related to large scale rearing. (Bull and Wond, 1962)
- 1473 Irradiation. A sterilization weapon against the corn borer. (Springell, 1963)
- 1476 On the role of lethal mutants in the control of populations. (Borstel and Buzzati-Traverso, 1962)
- 1479 Control of weevil populations *Sitophilus granarius* L. with sterilizing and substerilizing doses of gamma radiation. (Cornwell et al., 1962)
- 1482 The control of warehouse pests by gamma radiation. (Rasulov and Anastasiev, 1963)
- 1486 Effects of gamma radiation on some wood-boring insects. (Bletchly, 1961)
- 1493 Irradiation of fruits and vegetables in a mobile cobalt 60 unit. (Harvey, 1963)
- 1497 Les possibilités d'emploi des radiations dans la lutte contre les insectes. (Nardon, 1963)
- 1499 Utilisation des radiations ionisantes (^{60}Co) pour la protection des denrées contre les insectes nuisibles. Recherches relatives à la détermination des doses utiles pour assurer la stérilité des insectes. (Pesson, 1963)
- 1580 Travaux de recherches utilisant les isotopes et les rayonnements nucléaires en entomologie appliquée en France et dans les pays associés. (Pesson, 1962)

I-A-3 RECESSIVE MUTATIONS. VISIBLE MUTATIONS. SUBVITAL AND SEX RATIO EFFECTS

- 822 Abrahamson, S. POSSIBLE REPAIR OF X-RAY INDUCED MUTATION IN *Drosophila melanogaster**. (Abstr.) *Genetics* 46, 8 (1961) 845.

Dr. Newton Morton's observation that irradiated sperm produced a shift in sex ratio significantly larger than expected has resulted in our doing several large-scale experiments to determine underlying mechanisms. Males (v d y g) receiving 2700 r and corresponding controls were mated either to $sc^{41} B InS w^a sc^3$ (Basc-M-5) females or to y f reversed acrocentric females needing the Y chromosome for survival. Mating (1) yields the sex-linked recessive lethal rate; the second gives the induced sex ratio shift, found to be two or more times greater than expected from the lethal frequency. Dominant lethality, detrimental but nonlethal mutations and mosaicism were considered as possible causes for the discrepancy. — In the sex ratio scheme, loss of X or Y chromosome results in zygotic death; possible unequal sex chromosome dominant lethality should not be great enough to produce the observed shift. — Mating the F_1 patrocinous males to compound X females produced the control sex ratio rate, indicating that detrimental mutations were not the cause. — Mating about 1000 F_2 females from nonlethal Basc cultures produced an F_3 lethal rate corresponding to the control. Furthermore no lethals reverted. Therefore, lethal gonadal mosaicism was not operating to any appreciable extent. — If these factors play little role in producing the observed phenomenon, it seems likely that the sex ratio shift depends almost exclusively on sex-linked recessive lethality. — As a possible hypothesis, some induced mutations may be metastable. In the male zygote considerably fewer mutants might be repaired than in the female zygote. On this hypothesis the agent responsible for repair may be the unirradiated X. Alternatively somatic mosaicism without gonadal mosaicism resulting from early segregation in a two or more stranded chromosome structure remains a possibility.

* (See also *Rec. Genet. Soc. Amer.* 30: 1961, 55.)

- 823 Abrahamson, S., Friedman, L.D. THE LINEAR RELATIONSHIP BETWEEN X-RAY DOSE AND LETHAL MUTATIONS RECOVERED FROM CELLS TREATED AS SPERMATOGONIA IN *Drosophila*. (Abstr.) p.199 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Wild-type males of the Canton-S stock were irradiated with one of the following doses: 3000, 9000, or 12000 r. Each dose was delivered in two half-doses separated by a 24-h interval. For a 15-d period after irradiation, the males were supplied regularly with excess virgin females to exhaust the supply of germ cells which were post-gonial when treated. After 15 d, the males were singly mated with Basc/X-Y females. A single heterozygous Bar-eyed daughter from each P-1 male was subsequently tested for the presence of a sex-linked recessive lethal. The use of only one offspring from each irradiated parent eliminates the problem of dealing with clusters of cells descended from the same treated gonial cell. Our preliminary study demonstrated that 50% of the lethals obtained at 3000 r were recovered in such clusters. Confirmatory crosses were carried out on all lethals. Our criterion for lethality was the appearance of 10% or less of the wild-type class of males. The results to date are in remarkably good agreement with the rule of linearity of mutation rate to dose, as previously attained for spermatozoan cells. The data from two experiments are presented.

- 824 Alexander, M.L. THE ROLE OF RECOVERY MECHANISM AND OXYGEN EFFECTS UPON CHANGES IN RADIATION SENSITIVITY IN SPERM TREATED IN MATURE MALES AND FERTILIZED FEMALES OF *Drosophila*. *Genetics* 47 (1962) 1565-18.

An increase in biological damage in sperm treated in inseminated females was observed after treatment with either neutrons or x-rays. Recovery mechanisms cannot account for the high sensitivity with neutron treatment. The absence of recovery mechanisms was indicated by equal percentages of biological damage observed the first and second day after treatment with 2 MeV neutrons in air or with 14 MeV neutrons in nitrogen. The possibility of a post-radiation enhancement of radiation damage was observed when mature sperm were treated in inseminated females with x-rays in the presence of N_2 gas. The data indicate that an explanation for the increase in radiation sensitivity of mature sperm treated in fertilized females involves more than one factor, the relative importance depending upon the type of radiation and conditions at the time of irradiation. The neutron data show that the chromosomes change in some way to become more sensitive to radiation injury after fertilization. The x-ray data indicate that there may be differences in recovery occurring in genetic damage in sperm treated in males and inseminated females and that there is an increase in chromosome breakage which is associated with the increased sensitivity. There is also a correlation of an increase in chromosome breakage and the presence of oxygen and a possible post-radiation enhancement of radiation damage which may be associated with the presence or absence of O_2 . (From auth.)

- 825 Abrahamson, S., Himoe, E. INDUCED MUTATION RATES IN SPERM TRANSMITTED TO SONS AND DAUGHTERS IN *Drosophila melanogaster*. *Genetics* 48, 8 (1963) 1085-7.

Irradiated* second chromosomes in wild-type *D. melanogaster* males were scored for induced lethal frequencies when transmitted to male and female progeny. No difference was observed between these two groups, and it has been concluded that the sex of the zygote which receives the irradiated chromosome does not influence the frequency of lethal mutations recovered. (Auth. summary.)

* 3000 r x-rays.

- 826 Altenburg, E., Browning, L.S. THE RELATIVELY HIGH FREQUENCY OF WHOLE-BODY MUTATIONS COMPARED WITH FRACTIONALS INDUCED BY X-RAYS IN *Drosophila* SPERM. *Genetics* 46 2 (1961) 203-11.

Females were examined for the relative proportion of whole-body versus fractional mutations induced by x-rays (3000 r) in post-meiotic stages, in the X-chromosome of their male parent, at 14 visible loci. Parallel studies were made in a chemically treated and an untreated series. In the x-ray series, 93% of the mutations appeared to be whole-body, the remaining 7% being fractional. By contrast, in the chemically treated series and in the untreated (spontaneous) series, the percentage of fractionals was relatively high (30-67%). The implications of these results are discussed. In all 3 series the mutant tissue of the fractionals as a rule seemed to involve half of the body, as far as could be determined upon external examination of the fractions, and this is discussed.

- 827 Baldwin, W.F. THE EFFECT OF RADIATION DOSE RATE UPON THE PRODUCTION OF EYE COLOUR MUTATIONS IN THE CHALCID *Dahlbominus*. A/AG. 82/G/L. 717, Atomic Energy of Canada Ltd., Chalk River, Ont. 15 Dec. 1961. 12p.

All irradiations were confined to the larval stages of Dahibomimus fuliginosus (Nees) over the period from 5-9 d after propagation, i.e. after placing the females with host cocoons of the sawfly Neodiprion lecontei (Fitch). The genetic effects of acute (1000 r at 1000 r/min) and chronic (1000 r at 10 r/h) exposure from x-rays and Co⁶⁰ respectively were investigated. The difference in mutation rates for eye-colour mutations with type of exposure proved to be small (~1.2) and not significant. Such factors as species differences, the masking effect of differential survival, the comparatively high dose rate (10 r/h) in chronic irradiation, or differences in the stages of development during irradiation may account for the small difference observed in Dahibomimus, as compared with those observed by other workers for Drosophila and Habrobracon.

- 828 Baldwin, W.F. THE EFFECT OF RADIATION DOSE RATE ON THE PRODUCTION OF EYE COLOR MUTATIONS IN THE CHALCID Dahibomimus. Rad. Res. 17, 2 (1962) 127-32.

See 827. The induced frequency exceeded the spontaneous frequency by approximately 35 fold. In these experiments, female germ cells were exposed in the oögonial stages of development. A preliminary description of the eye-colour mutations and of defective individuals found in offspring of irradiated mothers is included in the paper.

- 829 Baldwin, W.F. DOSE RATE EFFECTS ON THE YIELD OF RADIATION-INDUCED EYE COLOUR MUTATIONS IN AN INSECT. p. 8 in "Radiation Biology in Canada 1962-63". CRB-1129, AECL-1701, Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 1963. 60p.

The investigation is carried out on the wasp Dahibomimus fuliginosus.

- 830 Baxter, R.C. RADIOBIOLOGIC STUDIES WITH Drosophila. (Abstr. B1F1005). p.73 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Genetic studies with D. melanogaster are centred upon the influence of dose rate and dose fractionation on recessive lethal mutation induction by ionizing radiation. Results so far agree with previously published findings by other workers with the mouse (Russell) and silkworm (Tazima and Kondo) that there is evidence for repair or recovery from genetic radiation damage.

- 831 Belitz, H.J. RECESSIVE LETHALS IN THE IV CHROMOSOME OF Drosophila melanogaster. (Abstr. 5.50) p. 72 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

After x-ray treatment of ey^Wey² males of D. melanogaster with doses of 3, 4.5 and 6 kr respectively 30 chromosomes with recessive lethals and 11 with semilethals were found. In allelic tests these 41 mutated chromosomes were outcrossed with each other. Two chromosomes contained two lethals each. Among the 43 mutations no more than 25 occupy one locus; the others are small deficiencies: 12 at least comprise 2 loci, 4 each 3 loci, and 2 four and 16 respectively. By aid of these overlapping deficiencies a part of this chromosome could be mapped over a range of about 20 loci including the locus of ci. Among the induced lethals two clusters were found; one consisted of 5 mutations induced in a spermatogonium and occupying probably one locus; the other was composed of two lethals, which gave a positive result in the allelic test, but proved to be overlapping small deficiencies including the locus of ci.

- 832 Berendes, H.D. THE SALIVARY GLAND CHROMOSOMES OF Drosophila hydei STURTEVANT. Chromosoma 14 (1963) 195-206.

A cytological map of D. hydei, one of the species of the repleta group, is presented together with some cytological observations, including the description of 3 x-ray-induced rearrangements. A mutant Ar (Aristapedia) is a dominant autosomal character located on the 2nd chromosome, lethal in homozygous condition. The autosomal dominant mutant, L (Lobe), is characterized by almost complete female sterility; homozygotes are lethal. The Do (Dorens) stock contains males in which some of the sensilla campaniformia on the wing are converted into conspicuous bristles; females are seldom affected. The map of D. hydei is compared with the existing map of D. repleta Wollaston. In addition to the large standard rearrangements, a number of small differences are indicated. On the basis of rearrangements, two of the linkage groups are attributed to definite chromosomes.

- 833 Borstel, R.C. von. INHERITED PARTIAL STERILITY IN Habrobracon. (Abstr. 7.23) p.124-5 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

After x-irradiation, 27 cases of inherited partial sterility were found in *Habrobracon*. Of these, 12 of the females had hatchabilities between 30 and 40%. Six were below 30%, 4 were above 60%, and 5 were between 40 and 55%. By classic theory, it can be assumed that the 40-55% class involved adjacent I segregation and the 30-40% class involved mostly adjacent I and adjacent II segregation. The other classes require additional interpretations such as multiple chromosome involvements for those with hatchabilities lower than 30%, and translocations involving chromosome ends for those with hatchabilities above 60%. The time of death of the duplication-deficiency products is extremely regular among all of the induced cases, occurring at midembryonic stages of development. On the other hand, embryonic recessive lethal mutations are expressed at all stages of embryonic development from the blastula stage to hatching. Very few cases of inherited partial sterility are found in progeny from females irradiated in prophase I or metaphase I; inherited partial sterility is commonly induced after irradiation of males with mature sperm. (From abstr.)

- 834* Brown, S.W., Bennett, F.D. ON SEX DETERMINATION IN THE DIASPINE SCALE INSECT *Pseudaulacaspis pentagonia* (Targ.) (COCCOIDEA). *Genetics* 48 (1957) 510-23.

The males are haploid (8 chromosomes) and the females diploid (16). Meiosis is normal in the female and replaced by a simple mitosis in the male. Egg production affords an example of combined sexual dimorphism and dichronism; the mothers first produce a series of eggs containing coral-coloured female embryos and then, without interruption, lay a series containing pinkish-white male embryos. Cytological study of early embryogeny shows that a chromosome set is eliminated to produce the haploid condition of the male embryos. Chromosomes broken by x-rays were used as genetic markers to demonstrate that the eliminated set is of paternal origin. Irradiation of fathers preferentially reduces the number of daughters. A similar effect on sex ratio following maternal irradiation cannot be explained on simple genetic assumptions and is believed to be attributable to a physiological effect of x-rays in predisposing the eggs to chromosome elimination. Aging of mothers prior to mating also results in a marked increase in the proportion of sons since differential mortality may be ruled out by inspection of ovarian contents, earlier onset of chromosome elimination is believed to be responsible for the effect of aging on sex ratio.

- 835* Carlson, E.A., Southin, J.L. PRELIMINARY PSEUDOALLELIC ANALYSIS OF X-RAY INDUCED MUTATIONS AT THE DUMPY LOCUS IN *D. melanogaster*. *Drosophila Inform. Serv.* 33 (1959) 124-5.

A series of x-ray-induced dumpy mutations in *D. melanogaster*, obtained at doses of 4000 and 1000 r administered to mature spermatozoa, was examined for gross and minute structural damage to genetic material. A recombinational analysis method was applied in testing the mutant with its neighbouring genes for the presence or absence of crossing over. Data are tabulated and results are discussed. (TID-3098, 4092)

- 836 Carlson, E.A., Southin, J.L. COMPARATIVE MUTAGENESIS OF THE DUMPY LOCUS IN *Drosophila melanogaster*. I. X-RAY TREATMENT OF MATURE SPERM - FREQUENCY AND DISTRIBUTION.

Evidence is presented to support the view that the majority of x-ray-induced mutations at the dumpy locus are gene mutations not associated with multibreakage events. Complete mutations (those affecting the entire body) form a mixed class of breakage events and gene mutations. The mutation frequency of the dumpy gene was not altered when sperm bearing a pre-existing dumpy mutation were used for irradiation. Gross mutation detected at the clot locus is 1/10 that of the dumpy locus. Criteria are evaluated for determining the true gene mutation frequencies at both loci. The results of the x-ray analysis of the dumpy locus support a theory of mutagenesis proposed by Muller, Carlson, and Schaefer (1961). (From auth.)

- 837 Carvalho, G., Cruz, M.P., da. DIFFERENCES IN SENSITIVITY TO GAMMA RADIATION IN *Drosophila* OF THE *willistoni* GROUP. AEC-TR-6429. n.d. no paging. (In Portuguese).

Three morphologically similar strains of *Drosophila* were compared. Virgin females (100) of *D. willistoni*, *D. equinoxialis*, and *D. paulistorum* were exposed to a Co⁶⁰ source for 2 min 6 sec so as to receive ~3000 r. Differences in radiation effects on viability, a sex-ratio factor, and response to different temperatures were found amongst the 3 species.

- 838 Crouse, H.V. X-RAY INDUCED SEX-LINKED RECESSIVE LETHALS AND VISIBLES IN *Sciara* (i.e. *Bradysia*) *coprophila*. *Amer. Nat.* 95, 880 (1961) 21-6.

A study was made of the sex-linked recessive lethal and visible mutations induced by x-rays in the sperm and oocytes (first meiotic prophase) of S. coprophila. For sperm irradiated at 2000 r, 3000 r, and 4000 r the lethal rates obtained were 0.0136, 0.0303, and 0.0348 respectively. Sperm and oocytes irradiated at 4000 r gave approximately the same lethal rate, 0.0348 versus 0.0437. On the basis of the experimental data the following interpretations have been made: (1) Sciara is not resistant to the mutagenic effects of x-rays. The low yield of visible mutations obtained repeatedly in this genus can be attributed to a number of factors, including the unusual mode of inheritance and sex determination found in these flies. (2) There is no correlation between the induction of chromosomal aberrations and the induction of sex-linked recessive lethals. When the latter are used as a criterion of sensitivity to x-rays, the response of sperm and oocyte (first meiotic prophase) are not significantly different. When chromosomal aberrations are used as a measure of sensitivity, however, the sperm are found to be highly sensitive whereas the oocytes are completely insensitive (zero aberrations). (From auth.)

- 839 Grouse, H.V. X-RAY EFFECTS ON SEX OF PROGENY IN Sciara (i.e. Bradysia) coprophila. Biol. Bull. 120, 1 (1961) 8-10.

X-ray experiments of 3 kinds were conducted on S. coprophila which clarify the mechanism of sex determination in this species. The data were interpreted to imply that irradiation can induce a sperm or oocyte to transmit an irregular number of sex chromosomes to the zygote; if, following chromosome elimination from the embryonic soma, a viable somatic complement (XX or XO) results, the embryo will differentiate accordingly into female or male.

- 840* Di Pasquale, A. THE "BROWN SPOT" CHARACTER IN Drosophila melanogaster AND THEIR RESPONSE TO X-RAYS. Atti Ass. genet. ital. 5 (1960) 117-26. (In Italian, with English Summary).

Some preliminary observations concerning a new character of D. melanogaster consisting in brown spots appearing on the abdomen of the females, some days after birth are reported. The brown spots are restricted to the hypodermal cells of the pleurae. Size and number of spots per individual are variable. This character appears in all isogenic chromosomal combination involving the second chromosome, derived from the wild stock Aspra 52, which fails to show spots, and has a manifestation of tumours (60%). The spots appear some generations after the establishment of the isogenicity. Treatment of larvae and pupae with x-rays fails to induce the spots in the males, but increases the size of the spots. A possible cytoplasmic effect is discussed, as well as the connection between brown spots and tumours. (Auth.)

- 841 Edington, C.W., Epler, J.L., Regan, J.D. THE FREQUENCY-DOSE RELATION OF X-RAY-INDUCED Y-SUPPRESSED LETHALS IN Drosophila. Genetics 47 (1962) 397-406.

An investigation was made to determine the frequency-dose relations of total sex-linked recessive lethals as measured by the S-5 technique and the two major classes of lethals, orthodox and Y-suppressed, of which they are composed. It was found that orthodox lethals increase linearly with increasing dose. Y-suppressed lethals, which behave for the most part as V-type position effects and constitute a large fraction (83% at 1082 r-17.3% at 4328 r) of total lethals at all doses studied, increase more rapidly than expected on the basis of linearity. When orthodox and Y-suppressed lethals were combined, it was shown that the frequency-dose relation of total lethals deviated significantly from linearity. The significance of these dose-response relationships to recessive lethal origin has been discussed. (Auth.)

- 842 Edington, C. A STUDY OF GENE AND CHROMOSOME CHANGES INDUCED BY IONIZING RADIATIONS IN Drosophila melanogaster. (Abstr. B1D255) p.45 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC, July 1963.

A study of the frequency of radiation- and chemical-induced fractional mutations in Drosophila is in progress. The utilization of special screening techniques allows the detection of F-1 females that are mosaic for sex-linked recessive lethal mutations. The mosaic females give rise to cultures in the F-2 generation that are scored as non-lethal cultures; however, an additional mating of the daughters present in these non-lethal cultures shows that some of the daughters are heterozygous for an induced lethal while their sisters are homozygous for the normal allele of the lethal. The average proportion of females that are heterozygous for a lethal from a mosaic F-1 mother can be used to estimate the probable number of basic strands in the chromosomes of Drosophila. In addition, studies are continuing on the investigation of the effect of the amount and distribution of heterochromatin in the X chromosome of Drosophila on the frequency of x-ray induced X-autosome translocations.

- 843* Falk, R. VIABILITY OF Drosophila HETEROZYGOUS FOR IRRADIATED CHROMOSOMES. Science 130, 3386 (1959) 1416.

Numerous lines were prepared such that they were originally homozygous and coisogenic for their second and their ve-marked third chromosomes, except for heterozygosity for the recessive marker st on their third chromosome. Half the lines had their ve st⁺ chromosome irradiated with a dose of 24 000 r, given to the spermatogonia. By backcrossing these lines to a coisogenic stock, homozygous for ve st, for a number of generations, viability could be measured. Viability of control homozygous lines was compared with that of the lines having one irradiated chromosome superposed on the same otherwise homozygous background. Viability of heterozygotes having one irradiated chromosome on a largely heterozygous but uniform background was also measured. Although many recessive lethal as well as detrimental mutations were induced, no increase in the average viability of the isogenic flies could be demonstrated as a result of the heterozygosity caused by the radiation-induced mutations.

- 844 Falk, R. ARE INDUCED MUTATIONS IN Drosophila OVERDOMINANT? II. EXPERIMENTAL RESULTS. Genetics 46 (1961) 737-57.

It was intended to investigate whether induced mutations when in heterozygous condition and unselected can increase the average viability of an otherwise homozygous genotype. The design of the experiment was such as to afford every chance for an induced increase in viability to be detected. More than 60 lines were prepared, each having an irradiated third chromosome marked with the gene ve, carried along with a ve st marked chromosome (coisogenic - except for the st locus and its vicinity - with the ve-marked chromosome before its irradiation), and homozygous as well as isogenic with respect to the second chromosome genes. A similar number of control lines, identical except for the irradiation, were also secured. The irradiation delivered to the treated lines comprised 6 doses of 4000 r each, given to males at 5-d intervals. The irradiated males were kept for 15 d after the last irradiation before deriving from them the offspring studied, so that practically only sperm that had been irradiated at spermatogonial stages was utilized. The reduction of viability caused by the presence in heterozygous condition of radiation-induced mutations ranged from 0-3%. Results also support the notion that non-lethal deleterious mutants are on the average relatively more dominant than lethals. The maximum increase in viability was found to be even lower than the minimum increase possible according to Wallace (Radiation, Genes, and Man. Henry Holt and Co., New York 1959) in which he found an average increase of 1.6% in the viability of lines heterozygous for radiation-induced mutations. The possibilities of inducing many overdominant mutations and maintaining them in a population are discussed.

- 845 Falk, R., Rahat, A., Himel, N. THE VIABILITY OF HETEROZYGOTES FOR X-RAY INDUCED MUTATIONS. (Abstr.) p.153 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Irradiation is known to induce many mutations deleterious to homozygotes and hemizygotes. The effect of these mutations in the heterozygous state (especially of the very common class, with only slight effects on viability in homozygotes) is of major importance for their survival and for the dynamics and evolution of populations. It has sometimes been suggested that x-ray-induced mutations would be neutral in heterozygotes, or might even confer increased fitness on highly inbred individuals heterozygous for them. The X-chromosome of Drosophila melanogaster is under study to determine, quantitatively, the viability of heterozygotes for x-ray induced mutations in spermatozoa and spermatogonia. The average degree of expression in the heterozygotes (dominance) of the deleterious effects detected in the hemizygotes has been calculated. Preliminary results confirm previous observations that the deleterious effect of x-ray induced mutations is also detectable in the heterozygotes. This seems to be so even for the range of mutations only very slightly affecting viability of the hemizygotes. A more detailed study on the correlation between the effect of a mutation on viability in the hemizygotes and that in the corresponding heterozygotes might lead to a better insight into the dynamics of natural and irradiated populations. Special attention is being paid to mutations which might, at least under certain conditions, improve viability.

- 846 Falk, R., Rahat, A. THE DEPENDENCE OF VIABILITY EFFECTS CAUSED BY IRRADIATION ON THE TYPE OF MATING. Proc. nat. Acad. Sci., Wash. 49, 3 (1963) 292-8.

The daughters of x-irradiated males and unirradiated control males were mated individually to 2 types of males of Drosophila melanogaster. The viability of males hemizygous for the irradiated chromosomes and of females heterozygous for the irradiated chromosomes was determined together with the corresponding control values. While the viability of males hemizygous for irradiated chromosomes was always reduced, the viability of females heterozygous for irradiated chromosomes was either reduced or increased, depending

on the type of mating. Intraculture competition differences were demonstrated to be responsible for the difference between matings. The heterotic effect was observed whenever the females heterozygous for the irradiated chromosome were able to replace the decline in the number of males hemizygous for irradiated chromosomes. The observed heterosis was therefore spurious, in that it was not in fact the effect of a viability of the heterozygote superior to that of either homozygote. It is suggested that some previous reports on differences in mutability between types of crosses or on heterosis of flies heterozygous for induced mutations were also caused by intraculture competition. (Auth.)

- 847 Falk, R., Ben-Zeev, N., Baker, S. EFFECTS OF IRRADIATED CHROMOSOMES ON VIABILITY IN HETEROZYGOTES AND HEMIZYGOTES. (Abstr. 5.56) p.74 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Drosophila males were irradiated with an x-ray dose of 2000 r and mated according to a design that permitted the determination of viability effects in both the heterozygotes and hemizygotes carrying the irradiated X-chromosome. Apart from the induced lethals and semi-lethals, the milder quasi-normal viability mutations could also be detected in the hemizygotes for irradiated chromosomes. In crowded cultures, when deleterious mutations caused a decline in the number of males hemizygous for the irradiated chromosome, the remaining genotypes competed for the available space. If the efficient competitors were heterozygous for an irradiated chromosome as well, the induced viability effect was offset in the final outcome by their advantage in competition. The heterozygotes for irradiated chromosomes thus exhibited a spurious increase in viability as compared with their controls which carried unirradiated chromosomes. When intra-culture competition was kept at a minimum it could be demonstrated that the induced mutations had an adverse effect on the viability of heterozygotes. The heterozygotes carrying semi-lethal mutations were the most seriously affected. The heterozygotes for quasi-normal chromosomes were considerably less viable than the controls, their viability being reduced at least as much as that of heterozygotes for lethals.

- 848 Fattig, W.D. A CHROMATOGRAPHIC AND SPECTROPHOTOMETRIC INVESTIGATION OF FLUORESCENT SUBSTANCES OCCURRING IN CERTAIN EYE-COLOR MUTANTS OF *Mormoniella vitripennis* (Walker).

A radiation-induced eye-colour mutant, *su*, which produces oyster-eyes in adult *M. vitripennis* has been shown to occur at the R-locus. Within the R-locus it occurs in a cistron other than *S*, and probably occurs in the O-cistron. One and 2-dimensional chromatography reveal that 2 R-locus mutants, *su* and scarlet-DR, both accumulate a blue-green fluorescent compound, designated 4b. This compound is present, but is not accumulated, in wild type organisms. Although phenotypic complementation occurs between *su* and *st-DR*, chemotypic complementation does not occur either *in vitro* or *in vivo*. Two possible explanations for these results are presented. The black (*bk*) mutant of *Mormoniella* accumulates 2 fluorescent substances. Hypotheses to explain these accumulations are proposed. In all, 9 fluorescent compounds occur on chromatograms of *Mormoniella* extracts. Ultraviolet absorption spectra for 3 of these substances are presented. One of these substances is found in both *Mormoniella* and *Drosophila*, and has not been reported in *Drosophila* before. (From abstr.)

- 849 Friedman, L.D. X-RAY INDUCED SEX-LINKED LETHAL AND DETRIMENTAL MUTATIONS AND THEIR EFFECT ON THE VIABILITY OF *Drosophila melanogaster*. Diss. Abstr. 21, 10 (1961) 2861.

The total decrease in viability in irradiated chromosomes can be separated into two components which will be called the lethal (L) and detrimental (D) genetic loads. The D:L ratio was found to be 0.125. This is a low value, but in much better agreement with the recent studies than the earlier ones. The present results together with those of Käfer suggest that the initial D:L ratio is much lower than reported by Timofeev-Resovsky and Kerks. The reasons for this discrepancy are not clear, but the newer results remove much of the basis for Greenberg and Crow's suggestions. (See their published work, as cited in the thesis).

- 850 Friedman, L.D. X-RAY INDUCED VIABILITY MUTANTS IN *Drosophila melanogaster*. (Abstr.) *Genetics* 46, 8 (1961) 865.

In order to determine the relative importance of lethal vs. detrimental mutations Muller-5 (Basc) and wild type males segregating from the same culture were irradiated with 1000, 3500, and 7000 r. These were mated with Basc/+ females from the same culture, and the F_1 heterozygous females mated individually with asc males which are the same as Basc except for the absence of Bar. The F_2 male progeny were counted, and the ratio of + to Basc where the Basc chromosome had been irradiated was compared with those where the + had been irradiated. The lethal frequency was .029/1000 r for the Basc chromosome

and .020/1000 r for Canton-S, a significant difference - Early studies by Timoffeef-Ressovsky and Kerkis showed a high fraction of the total genetic load to be due to detrimental mutations, whereas the more recent work of Kafer showed a smaller fraction. Our results are in close agreement with Kafer, the ratio of the detrimental to the lethal load being 0.125. In our studies a lethal was defined as having less than 10% of the normal viability. The results indicate that either very few detrimental mutations are induced or that individually they have very minor effects.

- 851 Frye, S.H. STRUCTURE OF "YELLOW" MUTATIONS INDUCED BY X-RAYS OF SCUTE⁸ CHROMOSOMES OF DIFFERENT GERM CELLS IN *Drosophila melanogaster*. (Abstr.) *Genetics* 46, 8 (1961) 965-6.

577 "yellow" mutations induced by x-rays in scute⁸ chromosomes of different germ cells were genetically analysed to determine their qualitative structure. Order of the loci is assumed to be *Il1*, *y*, *ac*, and *bb*. The symbol + indicates the normal allele while - indicates an affected or deficient locus, the locus involved being indicated by the position of the symbol. An additional lethal (if present) somewhere to the right of *bb* is symbolized as - in the 5th position. The following are structural frequencies of the "yellow" mutants x-ray induced in oögonia, oöcytes, and mature sperm, respectively: - - - + 4, - - - + 1 (total 5); - - - + 14, - - - 5, - - - 1, - - - + 3, - - - + 5, - - - + 3, - - - + 3, - - - 1 (total 35); - - - + 374, - - - 43, - - - 31, - - - + 16, - - - + 41, - - - + 22, - - - + 4, - - - + 1, - - - 2, - - - 3 (total 537). - All - - (+) (+) chromosomes of oögonia and oöcyte "yellows" were tested for translocations involving the 4th chromosome (Cat⁴). None of the oögonia "yellows" were capped by Cat⁴(IVR). Two of the oöcyte "yellows" (symbolized - - - -) were capped by Cat⁴(IVR). Mature sperm "yellows" were tested for the 2nd (*Il1*, *IlR*) and 4th chromosome tips. Twenty-two cases were found. Tips from *IlR* (11/22) exceeded all other autosomal tips detected. All yellow half-translocations were deficiency half-translocations. - The structure of breakage "yellows" in scute⁸ chromosomes is not dependent upon either the x-ray dose (even 10 spontaneous "yellows" were classifiable as either minute or gross structural changes) or the germ cell stage. - The means by which x-ray induced (and possibly spontaneous) breakage and intragenic mutation can be separated is still not available. A consideration of the frequency, functional and structural types of chromosome breaks and their interactions may yield a more realistic and unifying approach to transmissible changes (both forward and back) than the concept of intragenic mutation.

- 852 Frye, S.H. FURTHER INVESTIGATION CONCERNING THE COMPLEX PHENOTYPIC LINEARITY OF YELLOW MUTANTS X-RAY INDUCED IN SCUTE⁸ CHROMOSOMES OF *Drosophila*. p.204 in "XVI International Congress of Zoology, Washington, 20-27 August 1963, "Vol. II". Moore, J.A. Ed., Washington D.C., XVI International Congress of Zoology.

Young scute⁸ Bar males were x-rayed at a relatively high dose, 8000 r. Four post-treatment matings, or broods, were made every 24 h and consisted of treated males and virgin females containing the sex-linked marker, yellow body colour, and autosomal markers, echnoid eye, dumpy wing, and clot eye. Inseminated females from each of the four broods were transferred several times into fresh bottles. The treated males were removed from the fourth brood after 24 h and were discarded. Consequently, F₁ females were derived from eggs that had been fertilized by 1-d old, 2-d old, 3-d old, and 4-d old sperm from time of treatment. Exceptional yellow daughters were recovered among the expected F₁ Bar females. Simultaneous controls were run, and the total induced frequency was corrected. The total frequency of exceptional yellows from each (not all) of the 4 broods always fluctuated in the same direction, i.e., below the expected frequency for linearity (Brood I), above the expected frequency for linearity (Brood II), and below for Brood III. However, the totals of yellow mutants (from all 4 broods) induced in y⁺ scute-8 chromosomes of mature and nearly mature sperm by 8000 r were found to exhibit approximately a linear dose-frequency relation as reported for lower x-ray doses (Frye, *ibid*). Possible mechanisms as to why the curve continues to rise are discussed. (From abstr.)

- 853 Glass, B., Ritterhoff, R.K. MUTAGENIC EFFECT OF A 5-r DOSE OF X-RAYS IN *Drosophila melanogaster*. *Science* 133 (1961) 1366.

Minute bristle mutations, dominant mutations which occur at > 50 loci in the *Drosophila* genome, served as the basis of scoring. Both parents were irradiated with 5 r, so that the effective dose to the offspring was 10 r. A highly significant reduction in the number of progeny from the irradiated parents, amounting to 1.3% was found; other visible mutations were in excess, though not significantly. It may be tentatively concluded that an acute dose of 5 r produces mutations, at a rate linearly proportional to the effects at 1000 r and 2000 r, in the mature gametes of both sexes.

- 854 Glass, H.B. THE ACTION OF RADIATION AND OTHER MUTAGENIC AGENTS (1) IN INDUCING MUTATION IN Drosophila FEMALES, AND (2) IN CONTROLLING THE ACTION OF SPECIFIC GENES RESPONSIBLE FOR SUPPRESSING UNCONTROLLED GROWTH. TID-11809, Johns Hopkins Univ., Baltimore. 1961. p.7.
- Results are summarized from a study on the effect of a 5-r dose of x-radiation on the induction of mutations in D. melanogaster. Results are also summarized from tracer studies on metabolic pathways involved in the formation of brown-spot eye pigment and the suppression of tumour genes in D. melanogaster. (NSA 15:1961, 12717)
- 855 Glass, H.B. THE ACTION OF RADIATION AND OTHER MUTAGENIC AGENTS (1) IN INDUCING MUTATION IN Drosophila FEMALES, AND (2) IN CONTROLLING THE ACTION OF SPECIFIC GENES RESPONSIBLE FOR SUPPRESSING UNCONTROLLED GROWTH. Report Covering 9-Year Period, May 1, 1953 - April 30, 1962. TID-15901, John Hopkins Univ., Baltimore. 22p.
- Studies of the comparative mutagenic effects of ionizing radiations on males and females of D. melanogaster are described. Sex-linked recessive lethal mutations were induced in nitrogen, air, and oxygen at doses of 1000, 2000, 3000, and 4000 r. The frequencies of mutations obtained in spermatozoa were uniformly about 1/3 higher than the frequencies obtained for the same dose and condition of atmosphere in mature oocytes. The relative frequencies of recessive autosomal lethals in mature male and female germ cells were identical with the relative frequencies of sex-linked recessive lethals. In studies of point mutations and deficiencies involving specific loci, the rates in the male germ cells exceeded those in the female germ cells by a proportion equal to that found to apply to autosomal and sex-linked recessive lethals. Fertility was lost in both males and females when they were x-rayed as 80-h-old larvae and bred upon emerging as adults. Females recovered their fertility rapidly but the males did so at a much slower rate. A study was also made of the effects on the life span of two different mating regimens.
- 856 Glass, S. THE MUTAGENIC EFFECT OF A 5-r DOSE OF X-RAYS. Drosophila Inf. Serv. 36 (1962) 65-6.
- 857 Глембоский, Я.Л., Абелева, Э.А., Лапкин, Ю.А. ВЛИЯНИЕ ФРАКЦИОНИРОВАНИЯ ДОЗЫ ГАММА-ЛУЧЕЙ НА ЧАСТОТУ ВОЗНИКНОВЕНИЯ МУТАЦИЙ В СПЕРМАТИДАХ у Drosophila melanogaster. Радиобиология 1, 1 (1961) 120-2.
- Glumbotskiĭ, Ya. L., Abeleva, E. A., Lapkin, Yu. A. EFFECT OF FRACTIONATION OF THE GAMMA-RAY DOSE UPON THE FREQUENCY OF OCCURRENCE OF MUTATIONS IN SPERMATIDS OF Drosophila melanogaster. Radiobiology 1, 1 (1961) 361-72. JPRS-10170, 18 Sep. 1961. Translation from Radiobiologiya 1, 1 (1961) 119-22.
- The linear dose-frequency dependence of recessive sex-linked lethal mutations induced by γ -rays in Drosophila spermatids was found to be affected in the range from 1000 r to 2000 r, even when the 2000 r-dose was fractionated, with a 3 h-interval between each 1000 r. A similar change in the relationship occurred for dominant lethals. The validity of Russel's hypothesis to explain the phenomenon is challenged, i.e. that the death of the most mutable cells accounted for the observed retardation in the expected increase in mutation-frequency with dose.
- 858 Glumbotskiĭ, Ya. L., Abeleva, E. A., Lapkin, Yu. A., Parfenov, G. P. EFFECT OF FACTORS OF COSMIC FLIGHT ON FREQUENCY OF APPEARANCE OF RECESSIVE LETHAL MUTATIONS IN X-CHROMOSOME OF Drosophila melanogaster. p.303-24 in FTD-MT-62-78, n.d. Translation.
- Investigations of two strains of D. melanogaster established a mutagenic effect for the complex of factors encountered during space flight. Lethal mutations were checked cytologically, and 20 were identified as point mutations. It was concluded that these were induced by cosmic radiation. Vibration, acceleration, and weightlessness may influence the genetic effects of radiation during space flight. (NSA 17:1963, 35279)
- 859 Glumbotskiĭ, Ya. L., Abeleva, E. A., Lapkin, Yu. A. THE EFFECT OF SMALL DOSES OF IONIZING RADIATION ON THE FREQUENCY OF OCCURRENCE OF SEX-LINKED, RECESSIVE, LETHAL MUTATIONS OF Drosophila. (Abstr.) Soviet Bloc Mainland China Tech. J., Ser. VI Bio-Sci. 61-11 145, 26 (1963) n.p. English abstract.
- The preliminary results of experiments to study the effect of 20 r doses of radiation on the frequency of sex-linked, recessive lethals, in relation to (a) type of radiation γ -rays or high speed neutrons; (b) radiation intensity - single or repeated doses; (c) gamete development - mature sperm or spermatids; (d) interstrain

differences in spontaneous mutation rate. It is stated that little work has been done on the effects of sub-25 r doses, especially regarding the existence of a threshold and accumulative effects. The experiments were carried out on *D-18* and *D-32* (*D-18* and *D-32*) *Drosophila* lines, differing considerably in spontaneous mutation rate. Spontaneous and induced lethals were detected by the Muller-5 method. Co⁶⁰ γ-rays were delivered at 0.83 r/min. Experiments with high-speed neutrons began in May 1960, using a 1000 kV reactor, the dose intensity being 115 u/h. The results refer only to experiments with *D-32* line. The authors found that 5-r doses of γ-radiation increased the frequency of recessive lethals in sperm and spermatids and repeated radiation produced a cumulative, mutagenic effect. The relative frequency of recessive lethals per radiation induced by repeated 5 r γ-radiation agrees with the data of other authors using higher single doses. The mutagenic effect of high-speed neutrons is 1 1/2 - 2 times greater than that of γ-rays. Spermatids had a higher mutation rate than sperm, with both types of radiation. No threshold effect was demonstrated and it is suggested that, should a threshold be detected, it will be specific to the type of radiation, type of mutation, stage of gametogenesis, and the organism. The danger to human germinal cells of low doses of γ-rays, and especially, high-speed neutrons is stressed. There are 3 tables. (Auth.)

- 860* Green, M.M. COMPARATIVE MUTABILITY OF WILD-TYPE ISOALLELES AT THE WHITE LOCI IN *Drosophila melanogaster*. *Genet. Res.* 1, 3 (1960) 452-61.

The frequency and type of x-ray induced mutations at the *w* loci in the Canton and Oregon wild-type stocks was studied. No differences in the mutation rates were found. A significant difference was found in the mutation rates of recombinationally separable segments of the *w* loci. (Auth.)

- 861 Green, M.M. BACK MUTATION IN *Drosophila melanogaster*. I. X-RAY-INDUCED BACK MUTATIONS AT THE YELLOW, SCUTE AND WHITE LOCI. *Genetics* 46 (1961) 671-82.

The induction of back mutations by x-rays was studied using 7 independent sex-linked mutants in *D. melanogaster* and irradiating attached X females. Significant increases in the back mutation rates of the mutants *y^z*, *sc*, and *w^a* were found. No evidence was found that the back mutations were caused by recombination events or mutations to independent suppressors. Crossing over tests indicate that the back mutations are not associated with chromosome rearrangements. The problem of x-ray induction of back mutations is briefly discussed. (Auth.)

- 862 Green, M.M. BACK MUTATION IN *Drosophila melanogaster*. II. DATA ON ADDITIONAL YELLOW AND WHITE MUTANTS. *Genetics* 47 (1962) 483-8.

Further attempts to obtain x-ray-induced mutations at the yellow and white loci in *D. melanogaster* are reported. Of five independent white mutants tested, only *w^{bf}* yielded back mutants. Of the five yellow mutants studied, a single apparent reversal of the x-ray-induced mutant *y^{bk}* was found. The relationship of these data to previously reported back mutation data in *Drosophila* are discussed. (Auth.)

- 863 Gunson, M.M. CYTOLOGICAL EFFECTS OF X-RAYS IN RELATION TO DOSE-RATE IN *Drosophila melanogaster*. *Amer. Nat.* 96, 691 (1962) 347-52.

A cytological study has been made of 2 groups of sex-linked recessive lethals induced in spermatozoa of *D. melanogaster* by high and low intensity x-irradiation, the 2 dose-rates varying by a factor of 20. Although aberrations are found to be slightly more frequent in the high dose-rate group, no significant difference between the 2 series is apparent in this respect. The result of this cytological analysis is considered in relation to the question of an intensity effect in *Drosophila*. (Auth. summary)

- 864 Hannah-Alava, A. MUTATION RATES AT SPECIFIC LOCI IN *Drosophila melanogaster*. Period covered: November 1960 through April 1961. Supplementary Report for March and April 1961. TID-16428, Turku, Finland. Univ. 7p.

Progress is reported in studies on the genetic effects of x-radiation in *Drosophila*. Data are presented on radiation damage, as measured by mutation rates at specific visible autosomal loci, of male germ cells of two species of *Drosophila*. Emphasis was placed on the comparative mutation rates of gametes in different stages of maturation at the time of radiation exposure. (NSA 18;1962(28746)

- 865 Hannah-Alava, A. MUTATION RATES AT SPECIFIC LOCI IN *Drosophila melanogaster*. Final report November 1, 1960 through October 31, 1961. TID-16429, Turku, Finland, Univ. 31 Oct. 1961. 5p.

Effects of radiation were studied in terms of mutation rates at specific, visible, autosomal loci induced in male germ cells of different species of *Drosophila*, particularly with regard to different physiological states at the time of irradiation. The most satisfactory brood pattern proved mating individual males successively to 7-10 females per mating, on the 3rd, 5th, 7th, 10th, 12th and 14th day post-irradiation. A total of 61 recessive mutants at 2 loci were recovered in the experimental series, none in the controls. The difference in mutant incidence at the different loci is great enough to suggest that the loci are not mutating at the same rate. Different loci appear to have different mutation rates in different broods. The mutations in the 3rd chromosome were analyzed cytogenetically. 14 mutants at the *in* locus are being tested cytogenetically.

- 866 Hannah-Alava, A. MUTATION RATES AT SPECIFIC LOCI IN *Drosophila melanogaster*. Period covered: November 1, 1961 through April 1962. TID-16430, Turku, Finland. Univ. 7p.

The brood procedure was used for obtaining mutations. The percentage of fertile males was found to decrease progressively from brood 1 to 7 with the exception of brood 3 (6 to 8 d), which was lower than the last broods. The lowest number of offspring per male was found in the 3rd brood with a progressive increase from the 4th to the 7th broods. A progressive decrease in mutations from the 4th to the 7th broods was also found.

- 867 Hannah-Alava, A. RATES OF VISIBLE MUTATIONS AS RELATED TO THE MATURITY OF THE MALE GERM CELLS OF *Drosophila melanogaster* AT THE TIME OF RADIATION. (Abstr.) p.115 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 Aug. 1962". London, Silver End Documentary Publications, Ltd. 1962.

The effect of radiation damage, as measured by mutation rates at 10 recessive autosomal loci in *D. melanogaster*, was determined using the brood procedure to relate the temporal to the spatial pattern of spermatogenesis. Males, treated with 3000 r x-ray, were mated individually and sequentially to females with a recessively marked third chromosome, and the F_1 offspring heterozygous for the marked chromosome were inspected for phenotypic variants. Each variant was tested genetically for its heritability. As mutations at the specific third chromosome loci were mimicked by phenotypic dominant mutations and Minutes in the other chromosomes, mutation rates for these two types were also determined during the course of extraction and verification of the mutations at the specific loci. The rates were high for all 3 types of mutation in the first brood (1-3 d following treatment) but even higher in the next two broods (4-6 and 6-8 d). As the lowest fecundity was in the third brood, the rate of visible mutations appears to be higher in spermatids and probably also meiotic stages than in the mature sperm. The fourth brood (8-10 d) was characterized by a considerable decrease in mutation rates for all 3 types. In the 3 following broods (11-13, 13-15, and 15-d) the mutation rates dropped progressively suggesting that spermatogonia in different stages of maturation may have different sensitivities to radiation.

- 868 Hannah-Alava, A. THE RATES OF VISIBLE MUTATIONS IN SEQUENTIAL BROODS OF IRRADIATED *Drosophila melanogaster* MALES. (Abstr. 5.38) p.68 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

The brood pattern of recovered mutations was determined for three different types of visible-dominants and Minutes in all chromosomes and recessives at specific third-chromosome loci - in the progeny of *D. melanogaster* males of two genotypes: wild-type, Oregon-RS, males (Exp. I) and males heterozygous for 12 third-chromosome recessive markers (Exp. II), mated singly and sequentially to females of an appropriate genotype for detecting mutations at specific loci and/or crossovers. The males in Exp. I were 2-24 h of age and in Exp. II 24-48 h of age at the time of treatment (3000 r hard x-rays) and initial mating. The sequential broods derived from these males, mated up to 24 d, totalled 94 081 and 42 951 F_1 offspring for the irradiated and control series respectively. Except for the first brood (1-3 d) in which there was a lower incidence of mutations in the progeny of the older males than the younger males, the curves of induced mutational response were not significantly different in the 2 experiments. In the broods following the period of excessive sterility (6-8 d) 113 mutations were recovered from 46 922 offspring of the irradiated males. The slopes of the curves in the premeiotic broods (11-24 d) suggest that one of the consequences of radiation of the early gonial stages is elimination of the germ cells with potential visible mutations to a greater extent than elimination of germ cells with either induced crossovers or recessive lethals with no visible phenotype.

- 869 Heidenthal, G. EMBRYONIC LETHALS INDUCED BY X-IRRADIATION OF FIRST MEIOTIC METAPHASE OOCYTES OF Habrobracon. Genetics 47 (1962) 685-93.
- Two methods have been used to study the frequency of various kinds of lethals induced by x-irradiation of Habrobracon oocytes in 1st meiotic metaphase. The first method involved the study of hatchability of eggs laid by x-irradiated virgin females and by others which were x-rayed as virgins and then mated to untreated males prior to the egg-laying period (doses from 100 r to 1750 r). The second method involved tests of F_1 virgins which had developed from x-irradiated oocytes which were later fertilized by untreated sperm (doses of 500 r, 1000 r or 1500 r). Comparison and analysis of the two methods indicate that the lethals detected by the first method are a mixed group, which includes recessive lethals persisting in heterozygous conditions among the adult F_1 females, and a group of lethals which express themselves when heterozygous in larval and pupal stages.
- 870 Hirobe, T., Yazaki, T. DIFFERENCE OF RADIATION SENSITIVITY BETWEEN MALE AND FEMALE UPON THE EGG COLOUR-SEX-LIMITED, IN THE SILKWORM. (Abstr.) Jap. J. Genet. 37 (1962) 386. (In Japanese).
- 871 Ikeda, H., Moriwaiki, D. ON THE "FEMALE-PRODUCING FEMALE" IN Drosophila bifasciata. V. (Abstr.) Jap. J. Genet. 36 (1961) 381. (In Japanese)
- 872 Inagaki, E. THE COMPARISON BETWEEN WHOLE AND FRACTIONAL MUTATION RATE INDUCED BY X-RAYS IN Drosophila. (Abstr.) Jap. J. Genet. 37 (1962) 388. (In Japanese).
- 873* Indiana Univ. Foundation. Research Div., Bloomington. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN Drosophila. Progress Report on the past 12 months and Renewal Proposal for the period September 15, 1960 to September 14, 1961. TID-6042, 31 May 1960, 14p.
- 874 Indiana Univ. Foundation. Research Div., Bloomington. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN Drosophila. Progress Report on the past 12 months and Renewal Proposal for the period September 15, 1961 to September 14, 1962. TID-13002, 31 May 1961, 18p.
- Results are reported from studies on the relation between the dose rate at which γ -radiation from a Co^{60} source is delivered and its effectiveness in inducing lethal mutations in oögonia of Drosophila melanogaster. Results are included from preliminary studies on dose rate effectiveness of neutrons in inducing lethals in oögonia of Drosophila, the relation between the dose of x-radiation and the frequency of non-disjunction in the germ cells of Drosophila females, and the genetic aspects of somatic damage induced by irradiation in Drosophila. Data are tabulated on the frequencies of recessive lethals induced with the X chromosome of Drosophila. A list is included of publications by staff members during the period covered. (NSA 15: 1961, 23288)
- 875 Ives, P.T. FURTHER TESTS OF MUTATION FREQUENCIES IN SUCCESSIVE SPERM BROODS AFTER 1 hr OF GAMMA RAYS. (Abstr.) Genetics 46 (1961) 873.
- Virgin Oregon-R/hes males, irradiated at 48-60 h after eclosion, were mated singly to 6 vg se females daily. F_1 males were tested for Y, 2 and 3 chromosome translocations. A marked peak in frequency (10-15%) occurred in days 5 and 6 sperm, with < 1% in days 7-12. Oregon-R/rucua males irradiated at 0-12 h showed a similar frequency pattern except that the peak (19%) appeared in day 7 sperm. That posteclosion age by itself did not cause this pattern change was shown by testing irradiated 0-12 h, 48-60 h and week old virgin Oregon-R/ruc-th (rucua without th) males. Each age group showed a pattern like the 48-60 h Oregon-R/hes. Simultaneous tests of 0-12 h Oregon-R/rucua and Oregon-R/ruc-th are in progress. - For tests of the T frequency in early vs. late-emerging F_1 of irradiated males, flies from non-crowded cultures stored by day 5 sperm (24-h laying period) were collected daily. The frequency was only half as high in F_1 males emerging in day one (roughly 20% of the total F_1 male hatch) compared to later days none of which differed from each other. Parallel X-linked mutation frequencies in semisibling F_1 females collected daily and tested by Basc showed no differences between days. F_1 samples are routinely taken in standard mutation rate tests here when more than 95% of the flies have emerged.
- 876* Jackson, C.E. A MUTANT IN Anopheles gambiae. Trans. roy. Soc. Trop. Med. Hyg. 51 (1957) 294.
- In order to obtain mutants with a view to establishing linkage groups in A. gambiae, about 275 males were exposed to a dose of 1000 r x-rays. This was done using 140 kV, mA5 for 10 mins 18 secs. These males were mated with unexposed, unfertilized females from the same colony, and the F_1 and F_2 females

examined. Several females were found with 4 distinct bands on the palps as compared with the normal wild type 3-banded palp. An examination of 200 females of the parent colony showed no such 4-banded females. Taxonomically this 4-banding is characteristic of the variety *A. gambiae melas*.

- 877* Karlik, A. GENETICAL STUDIES WITH *Drosophila ambigua* Pom. Z. Vetterblehre 89 (1958) 448-58. (In German).

5 sex-linked, 1 partially sex-linked and 13 autosomal genes are recognised from new mutations, mostly produced by x-rays. A linkage map for the X-chromosome is presented. Homologies between these genes and genes in other *Drosophila* spp. are discussed. (TID-3098, 4134)

- 878 LaChance, L.E., Hopkins, D.E. MUTATIONS IN THE SCREW-WORM FLY. J. econ. Ent. 55, 5 (1962) 733-7.

A search was conducted to find mutants useful for marker stocks. Flies scanned for mutations came from 3 sources: (1) untreated laboratory-reared flies, (2) progeny from irradiated normal parents, and (3) progeny from irradiated flies inbred for 2 generations. Nine mutations are described for *Cochliomyia hominivorax* (Coquerel): 7 are dominant, 5 affecting wing characteristics, 1 body colour, and 1 oral vibrissae; 2 are sex-linked recessives, 1 affecting body colour and 1 affecting wing venation. Pertinent genetic data are presented for each mutant stock.

- 879 Lee, W.R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. Progress Report for 1961 and Renewal Proposal of Contract for 1962. TID-14212, New Hampshire. Univ., Durham. 6p.

The spectrum of viability mutations ranging from dominant lethals to detrimentals in haploids that resulted from irradiating semen from a single haploid male was studied in the honey bee. From the decrease in viability of diploid progeny following irradiation of the spermatheca of the parental queen, it was calculated that one or more dominant lethals were induced in 60.8% of the sperm cells. In a separate test using the same dosage on an unrelated queen 60.9% dominant lethals were found. The values obtained by irradiating semen in the spermatheca of queens with 2000 r of 50 kV x-rays were equal to 2500 r applied to semen in the spermatheca of males. Recessive mutations and mutants with incomplete dominance were detected in haploid progeny of F_1 queens.

See also TID-4200, abstr. 81D302.

- 880 Lee, W.R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. Progress Report. TID-17579, New Hampshire, Univ., Durham. 1962. 7p.

Results of experiments on partial-body irradiation of queen honey bees show that irradiating the segments III through V of the abdomen produces the same lethal effect as whole-body irradiation, whereas irradiating any other body region does not produce a significant amount of radiation deaths during the following three weeks. Apparently, irradiation of segments III through V of the abdomen prevents the replacement by cell division of the digestive cells lining the ventriculus, and the queen then starves for lack of proper digestion. It is concluded that variations in the normal rate of cell division in the ventriculus of various insects and in the length of time different species can go without food can explain the great variation in resistance of adult insects to irradiation. (NSA 17:1963, 7799)

- 881 Lee, W.R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. NYO-2315-1, New Hampshire, Univ., Durham. 1963. 7p.

The frequency of recessive detrimental mutations expressed in the haploid drone honey bee was investigated and compared with recessive and dominant lethal mutations detected in the haploid drone and diploid worker. (See 880). A single queen was inseminated by a drone homozygous for 3 genetic markers. Viability of progeny was determined, and hybrid daughters bearing the genetic markers were stored in colonies. The spermatheca of the queen was then irradiated with 2600 r kVp x-rays. Morphological defects and viability were studied in progeny and grand-progeny. A total of 92 pairs was then tested during one season. Results showed that 60.9% of the sperm cells receiving radiation (out of 2996 tested) contained at least one or more dominant lethals. Correcting for the saturation effect on the assumption of independence of each dominant lethal, an average proportion of 0.94 dominant lethals were found per gamete. The average reduction in embryonic viability was 28%. The post-embryonic viability ratios showed a bimodal distribution, presumably due to point mutations. Forty percent (31/77 pairs of queens tested) contained 1 or more recessive lethals. Correcting for the saturation effect the frequency of recessive lethals is 0.51. Emphasis was also placed on the production of mutations in oögonial cells of queens so that

mutations could be detected in the queen's haploid progeny. By means of partial body irradiation it is now possible to give doses as high as 5000 r to oögonial cells, and additional work on effects of dose fractionation on queen viability and sterility is in progress.

- 882 Lindsley, D.L., Camba, C., Warters, M. THE CORRELATION BETWEEN RADIATION-INDUCED MALE STERILITY AND RECIPROCAL TRANSLOCATION IN Drosophila. (Abstr.) p.153 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

It has been observed that males of Drosophila melanogaster that carry a reciprocal translocation between the X chromosome and chromosome II or III are frequently sterile. X chromosome inversions and insertional translocations, on the other hand, do not generally lead to male sterility; thus the sterility is not attributable to break-associated mutation or position effect, but is dependent on reciprocal translocation as such. The experiments to be reported were designed to answer two different questions: (1) What proportion of sex-linked male-sterile mutations are associated with T(X; A)'s? (2) What proportion of T(X; A)'s are male-sterile? A sample of 120 sex-linked recessive male sterilizing changes was induced with Cs¹³⁷ γ -radiation and put into balanced lines. Each of these lines is being tested for the presence of a T(X; A) by three criteria: (a) Salivary chromosome analysis, (b) Incidence of primary non-disjunction of the X chromosomes in T(X; A)/FM6 females, and (c) linkage analysis. The results to date suggest that approximately 80% of all sex-linked recessive male steriles are associated with X-autosome translocations. A sample of 140 T(X; 2)'s and T(X; 3)'s was induced by x-rays in mature sperm and recovered from test crosses of daughters of the irradiated males. Of those which survive as males approximately 75% (88/116) are male-sterile.

- 883* Meyer, H.U., Muller, H.J. GENETIC EFFECTS OF HIGH DOSES OF X-RAYS IN OÖGONIA. Drosophila Inform. Serv. 32 (1958) 137.

- 884 Meyer, H.U., Muller, H.J. SIMILARITY OF X-RAY-INDUCED MUTATION RATE IN GONIA OF Drosophila FEMALES AND MALES. (Abstr.) Genetics 46, 8 (1961) 892-3.

Early gonidia are agreed to have the lowest x-ray-induced mutation rate of all germ cell stages of adult D. melanogaster. However, reports have disagreed concerning whether their rates are alike in both sexes. Our present experiments have investigated the frequency of second chromosome recessive lethals induced in early gonidia of both sexes x-rayed simultaneously with 4000 r (100 kVp, 240 r/min). Lethals induced in cologenized chromosomes carrying *tes-m-b-cn-sp*, of flies heterozygous for Curly-Oster, were detected by "criss-cross sterility" tests improved since Muller's Drosophila Inform. Serv. description. Individually identified young females and males, breeding for 3 d just before irradiation, produced control progeny denoted "YFC" and "YMC", respectively, and, after a 10-d or 15-d post-irradiation period of active breeding, produced experimental progeny denoted "10FX", "15PX" and "15MX", respectively. As another control, "15MC", progeny were taken from other males, unirradiated, after breeding them as long as those irradiated. Determination of induced lethal rate was made unusually accurate by allelism tests of lethals derived from the same parent before and after irradiation, some spontaneous mutations being thereby excluded from the "rectified" experimental rate. Allelism tests also disclosed "clustering" within experimental or control sibships, thus permitting more accurate standard error determinations (Muller 1952, GSA Records). Harmonically weighted mean frequencies (Muller 1941, Am. Naturalist) of six such experiments gave, for "unrectified" controls: YFC (3159 chromosomes tested) $0.61 \pm 0.10\%$, YMC (2718) $0.29 \pm 0.11\%$; 15 MC (2282) $0.17 \pm 0.08\%$. For "rectified" experimentals: 10 FX (1962) $6.3 \pm 0.7\%$; 15FX (1441) $6.5 \pm 0.6\%$; 15 MX (2029) $7.4 \pm 1.2\%$. These results, which for oögonia concur with our previous X chromosome results, show no significant sex difference.

- 885 Moriwaiki, D., Tobari, I., Kitagawa, O., Ohba, S., Tobari, Y., Ikeda, H., Ichida, H. A SHIFT OF SEX-RATIO IN THE PROGENY FROM IRRADIATED MALES IN Drosophila melanogaster. Preliminary Note. A/AC.82/G/L.731, United Nations Scientific Committee on the Effects of Atomic Radiation, December 1961. 4p.

The sex-ratio changes in the progeny of males irradiated at different stages of the germ cells in D. melanogaster were investigated. Using the isogenic Oregon-R wild strain, male flies of 4±2 h-old were irradiated with 1000 r, 2000 r, and 3000 r and were crossed with the same wild type females of about 3 d-old. The sex-ratio changes were found to be dependent on the dose as well as the germ cell stage. The sex-ratio shifted to the lowest level in the group where progenies came from males of 6 to 8 d after irradiation. Each class sex-ratio was depressed in proportion to dose and the coefficient was 0.0237 per 1000 r on the

average. (NSA 16:1962, 11426)

(Also published as abstract only, in Japanese, in Jap. J. Genet. 36:1961, 388).

- 886 Moriawaki, D., Tobari, I., Kitagawa, O., Ohba, S., Tobari, Y.N., Ikeda, H., Fayama, Y., Kirimura, N. A SHIFT OF SEX-RATIO IN THE PROGENY FROM IRRADIATED MALES IN Drosophila melanogaster. II. (Abstr.) Jap. J. Genet. 37(1962) 399. (In Japanese).
- 887 Mukai, T., Chigusa, S. X-RAY INDUCED POLYGENIC MUTATION RATE IN Drosophila melanogaster. (Abstr.) Jap. J. Genet. 36(1961) 388. (In Japanese).
- 888 Mukai, T., Yoshikawa, I., Chigusa, S. RADIATION INDUCED MUTATION RATE OF POLYGENES CONTROLLING THE STERNOPLURAL BRISTLE NUMBER IN D. melanogaster. (Abstr.) Jap. J. Genet. 37(1962) 400. (In Japanese).
- 889 Mukai, T., Chigusa, S. RADIATION-INDUCED MUTATION RATE OF POLYGENES CONTROLLING THE NUMBER OF STERNOPLURAL BRISTLES IN Drosophila melanogaster. Ann. Rep. nat. Inst. Genet., Mishima, 1961. 12(1962) 83-5.
- 890 Müller, I., Löbbecke, E.A., Olmanns, O. DOSE EFFECT CURVE OF SOMATIC MUTATIONS IN Ephestia kühniella Z. FOR LOW DOSE-RANGE (0-200 r). Nature, Lond. 194(1962) 783-4.
- Groups of Ephestia kühniella Z. (meal moth) pupae were irradiated with 0, 10, 20, 40, 80, and 200 r x-rays and both wings of each individual examined for scale mutations. The results for the most frequent type of mutants (ES 1) show that in the range of 20 to 1000 r the mutation frequency is proportional to the square of the dose, whereas for 0 and 10 r this relation no longer holds good. (NSA 16:1962, 20281)
- 891 Muller, H.J., Falk, R. ARE INDUCED MUTATIONS IN Drosophila OVERDOMINANT? I. EXPERIMENTAL DESIGN. Genetics 46(1961) 727-35.
- The background of the problem of overdominance and the plan of experiments to test for overdominance of induced mutations are presented. For experimental details, see 844.
- 892* Nelson-Rees, W.A. A STUDY OF SEX PREDETERMINATION IN THE MEALY BUG Panococcus citri (Risso). J. exp. Zool. 144, 2(1960) 111-37.
- An investigation of sex pre-determination was initiated in an attempt to elucidate the mechanism ultimately responsible for sex determination in this and other coccids of the lecanoid section of the superfamily. The life cycle and the behaviour of the mealybug in culture on potatoes are described. Survival curves of offspring (% of each sex) following pre-mating irradiation (1000 and 2000 r x-rays) of mothers of various ages indicated a differential sensitivity of eggs which were to yield either male or female offspring. Daily laying patterns of treated females indicated that aging of the female prior to mating changed the nature of the sensitivity of ovarioles at the time of treatment to x-ray-induced lethality and thus altered the sex ratio of the total surviving offspring. Whereas young females readily supported the development of triploid females (31-35% of control females) through utilization of polar body fusion nuclei when they were mated to males previously treated with high dosage γ -irradiation (60 000-120 000 rep), aged females did so to a lesser extent (10%) or not at all. It is believed that the sex of the embryo is controlled by the stage of development of the ovarioles, i.e., (1) the stage in meiosis of the oocyte, and (2) the nature of the egg cytoplasm at the time of fertilization. (From auth. summary)
- 893 Nirula, S., Swaminathan, M.S., Natarajan, A.T., Sharma, R.P. INCIDENCE OF MUTATIONS IN Drosophila melanogaster RAISED FROM FLIES FED ON IRRADIATED MEDIUM. (Abstr. 5.34) p.66-7 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.
- Earlier studies at the Indian Agricultural Research Institute on the effects of culture media, potato mash and fruit juices irradiated with ionizing radiations on mitosis in root meristems of barley, Vicia faba and onion grown on them have revealed that such irradiated products may have radio-mimetic effects. In view of the obvious bearing of these data on assessing the wholesomeness of food material sterilised through ionizing radiations, a study was initiated in D. melanogaster to ascertain whether the mutational load is enhanced in flies fed with irradiated food. The basic medium consisting of glucose agar and yeast is irradiated with 150 krad of γ -rays (sterilizing dosage) at a 160-c- Co^{60} source. Young Oregon-K flies (soon

after emergence) are fed on this irradiated medium. The flies are allowed to breed and parent flies are killed about 7 d later. The male flies which emerge out of the larvae fed exclusively with irradiated food are then used for conducting M-5 tests on normal culture medium for further F₁ and F₂ breeding. The experiments have been repeated thrice. Sex-linked recessive lethals have been found only in the families derived from the irradiated medium-series (6.44%). A wide range of phenotypic changes was a striking feature of the F₂ families from the irradiated medium cultures (their frequency ranging from 0.13-0.37% against 0.018-0.095% in control on population basis). Some of the mutant flies, viz. curly wings, yellow body, and another with dominant wing mutation were found to breed true. A few changes like half thorax, rotated abdomen and absence of neck belong to the non-inherited group of abnormalities of Morgan (Bridges and Sturtevant 1925) they were observed only in the irradiated medium series. The implications of these studies will be discussed.

- 894 Nur, U., Chandra, H.S. INTERSPECIFIC HYBRIDIZATION AND GYNOGENESIS IN MEALY BUGS. Amer. Nat. 97 (1963) 197-202.

Gynogenetic females are known to develop after heavy doses of paternal irradiation in Planococcus citri (Risso). In attempts to induce gynogenesis 90 000 rep (from a Co⁶⁰ source) were administered to males of Phenacoccus gossypii Towns and Ckll. and Pseudococcus gahani Green, and 70 000 rep to Pseudococcus obscurus Essig. The first two attempts failed. However, gynogenetic Planococcus citri daughters were obtained after Pl. citri females were mated to irradiated Ps. gahani males.

- 895 Purdom, C.E., McSheehy, T.W. DOSE-RATE AND THE INDUCTION OF MUTATIONS IN Drosophila. (Abstr.) Int. J. Rad. Biol. 6, 5 (1963) 491.

The lower efficiency of low-dose-rate irradiation on the induction of mutations in immature germ-cells, as discovered by W.L. Russell and his colleagues in the mouse, has not been demonstrated conclusively in other higher organisms. Some reports of studies in Drosophila and Bombyx claim a dose-rate effect, but in each case there are reasons for doubting an exact parallel with the phenomenon in the mouse. An early experiment by the present authors gave some evidence for a dose-rate effect in spermatogonia of Drosophila; this result however, could not be confirmed. The present paper deals with a continuation of these dose-rate studies, comparing dose-rates of 0.05, 0.5 and 5.0 rads/min. Information was obtained on the induction of second chromosome recessive lethal mutations in spermatogonia and other germ-cell stages in the testis. There was no evidence of a dose-rate effect in any of these male germ-cells.

- 896 Puro, J.A. TEMPORAL PATTERN OF THE EARLY STAGES OF SPERMATOGENESIS OF ADULT Drosophila melanogaster MALES AFTER TREATMENT WITH X-RAYS. (Abstr.) p.116 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

Adult males of D. melanogaster were treated with 3000 r x-rays and then mated individually to virgin females during the whole period of fertility of the male to obtain sequential broods from cells in successively younger stages of spermatogenesis at the time of irradiation. Studies were made of third chromosome lethal and visible mutations in the broods, following the period of maximum sterility, i.e. the third brood (8-8 d after irradiation). Clusters were detected by cross-testing mutations from the same male for identity. Using the total size of clusters (as measured by the number of identical mutations found) and the relative size of clusters (calculated as percentage of identical mutations from the total tested in a brood) as a criterion, the spatial pattern was related to the temporal pattern of early spermatogenesis. The results suggest that mutations occurring in the young spermatogonia are available much earlier than has been supposed previously. The sperm available at the time of highest fecundity following the sterile period seem to originate from primordial cells. The data suggest that the secondary gonads at the time of irradiation have a rather limited period in the brood pattern.

- 897 Saul, G.B.H. HAPLOID INTERSEXES IN Mormoniella. Genet. Res. 3, 3 (1962) 242-7.

Intersexes were found in a culture containing progeny of an unmated female which had arisen from the cross of oy-NH females with x-rayed wild-type males. Genetic evidence indicated that the intersexuality was due to mutation, and not to chromosomal aberration. The intersexes showed a gradient from anterior maleness to posterior femaleness, and were less masculinized than similar types reported in Habrobracon juglandis. (Auth.)

- 898 Shiomi, T., Inagaki, E., Tachibana, H., Nakao, Y. MUTATION RATES AT LOW LEVEL IRRADIATION IN *Drosophila melanogaster*. (A Preliminary Report). A/AC.82/G/L.734, Japan. National Inst. of Radiological Sciences, Tokyo. Dec. 1961. 7p.
- Preliminary results of studies in *D. melanogaster* led to the conclusion that there is a linear relation between mutation rates and radiation dose down to 8 r. Sex-linked recessive lethal mutations were used as indicators of mutation induction. No evidence was seen of a threshold dose in genetic effect for doses of x-radiation down to 8 r. (NSA 16:1962, 11427)
- (Also published as abstract only, in Japanese, in Japan. J. Genet. 36, 1961, 395)
- 899 Shiomi, T., Inagaki, E., Tachibana, H., Nakao, Y. MUTATION RATES AT LOW LEVEL IRRADIATION IN *Drosophila melanogaster*. (Abstr.) p.198 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.
- The study was aimed at testing whether a linear relationship (down to 8 r) holds for sex-linked recessive lethals in *Drosophila*. Methods and materials used were based on data obtained by Spencer and Stern (1948). A wild-type Canton-S strain was used which was isogenized before the experiment and again every 4 months. About 400 one-week-old males were irradiated together in each experiment. The doses used were 8, 15 and 25 r. The results are based on 500 000 chromosomes.
- 900 Stern, C. THE CELL LINEAGE OF THE STERNOPLURA IN *Drosophila melanogaster*. Devl. Biol. 7 (1963) 365-78.
- Larvae of *D. melanogaster* were irradiated with x-rays to induce somatic crossing over resulting in genetically marked mosaic areas. Mosaic sternopleural sclerites were associated with mosaic mesonota in frequencies compatible with random association. Association of mosaic sternopleurae and mosaic legs was significantly more frequent than accountable by chance. It is concluded that the sternopleura is always derived from the ventral, not from the dorsal, disk. Apparently differing results of earlier authors are re-interpreted in terms of embryonic indeterminism as contrasted to larval determination of prospective imaginal areas. (Auth.)
- 901 Stern, C. RADIATION AND MUTATION RATE. (Abstr. B1F1114) p.73 in "Research and Development in Progress, Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.
- The prime object of this project is the relationship between radiation and mutation rate. Much effort is on spontaneous mutation rates, the analysis of which includes small point mutations as well as chromosome aberrations. Work in progress is concerned with further studies of the intersex mutant, induction of mutations and mitotic crossing-over by heat shock, and problems of fertilization in *Drosophila melanogaster*. Developmental studies are centred on mosaic types produced by irradiation and also on gynandromorphic and mosaic types produced genetically.
- 902 Swaminathan, M.S., Nirula, S., Natarajan, A.T., Sharma, R.P. MUTATIONS: INCIDENCE IN *Drosophila melanogaster* REARED ON IRRADIATED MEDIUM. Science 141 (1963) 837-8.
- An increase in the rate of mutation has been found in *D. melanogaster* reared on a basic medium that was irradiated with a sterilizing dose (150 000 rads) of Co^{60} γ -rays. In Muller-5 tests, sex-linked recessive lethals occurred only in the F_2 progenies of the male test flies obtained from breeding the parent flies on irradiated medium, while visible changes occurred in experimental cultures from both the control and irradiated media. The frequency of sex-linked recessive lethals was 0.35, 0.55, and 0.8% in 3 independent experiments. Visible changes were 2-6 times more frequent in the irradiated series than in the controls. (Auth. Summary)
- 903* Tsujita, M. X-RAY INDUCED MUTANTS IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 6 (1956) 63-5. (In Japanese).
- 904* Tsujita, M. STUDIES ON THE COMPLEX NI-U-DI LOCI IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 7 (1957) 54-5. (In Japanese).

- 905* Tsujita, M. ON THE Nl^2 GENE BELONGING TO THE U -ALLELIC SERIES IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 8 (1958) 48-9. (In Japanese).
- 906* Tsujita, M. ON LETHAL Nl^1 AND Nl^2 EMBRYOS OF THE SILKWORM. Annu. Rep. nat. Inst. Genet. 9 (1959) 13-15.
- 907* Tsujita, M. GENETIC AND BIOCHEMICAL STUDIES ON THE NEW WHITE-EGG MUTANT IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 10 (1959) 13-5.
- The mutant strain of the silkworm, w^{OX} , which exhibits a conspicuously transparent larval hypodermis and white eggs was obtained by x-ray treatment in 1954. The gene w^{OX} belongs to the Xth linkage group, and crossing experiments show it to be allelic to w^{OL} on chromosome Xth. Amounts of uric acid and isoxanthopterin produced in the hypodermis of larvae homozygous for w^{OX} , w^* , w^{OL} and of their hybrids were measured by a paperchromatographic method. The amount of uric acid in the hypodermal tissue of the w^{OX} homogeneous larvae is only 1/100 of that found in the w^{OL} larvae and 1/10 of that found in the od larvae. It is characteristic of the w^{OX} mutant that its amount of uric acid and isoxanthopterin are much smaller than in any other known mutant strain with transparent larval hypodermis. The change in amount of isoxanthopterin in the hypodermal tissue after injection of 2-amino-4 hydroxypteridine into the larval body cavity was investigated; the normal amount of isoxanthopterin reappeared after 24 h. It may be assumed that isoxanthopterin and uric acid newly produced in the hypodermal tissue penetrate into the body cavity, passing through cell membranes, and that the permeability of the substances is controlled by w^{OX} or w^{OL} .
- 908* Tsujita, M. X-RAY INDUCED Nl -TYPE MUTANTS OF THE SILKWORM. Annu. Rep. nat. Inst. Genet. 10 (1960) 16-17.
- 909 Tsujita, M. INVESTIGATIONS IN Nl TYPE LETHAL MUTANTS OF THE SILKWORM, WITH SPECIAL REFERENCE TO Nl , Nl^1 AND Nl^2 EMBRYOS. Jap. J. Genet. 36 (1961) 235-43.
- A number of larvae showing the Nl phenotype were obtained by irradiation (8000 r x-rays) of PHg^{Kp}/PHg^{Kp} individuals. The 3 Nl types, Nl , Nl^1 and Nl^2 , were investigated. From crossing experiments, it is assumed that Nl mutants are caused by deficiencies in the part of the 14th chromosome which includes the oa locus and that the order of their relative lengths for the 3 types is $Nl > Nl^1 > Nl^2$. It was observed that embryos homozygous for Nl^1 die at a far more advanced stage than embryos homozygous for Nl and that the development of the embryos homozygous for Nl^2 advances still a little further. Thus, the difference in the extent of the deficiency in each of the three Nl mutants relates to the stage at which the respective homozygous embryos die. Spontaneous Nl type mutation occurs very rarely. However, it may be said from the present experiment that the frequency of the mutation increases strikingly as a result of irradiation with x-rays and that the extent of the deficiency in each of the Nl type mutants is not always the same. (Auth. summary)
- 910 Turku, Finland. Univ. THE MUTATION RATE AT SPECIFIC AUTOSOMAL LOCI IN DIFFERENT SPECIES OF Drosophila. 8 Month Progress Report. TID-13038. n.d., 10p.
- The effects of radiation damage, as measured by mutation rates at specific visible autosomal loci, upon the male germ cells of Drosophila was studied with special emphasis upon comparative mutation rates of gametes in different stages of maturation at the time of radiation. Information on the brood patterns, and data on the kind and incidence of mutations as related to the brood patterns are summarized. A clearly defined reduction in number of offspring was found to occur in the 3rd brood (6 to 8 d following radiation) although the number of offspring is also considerably reduced in the 4th brood. The data point to a difference in mutation patterns as well as mutation rates for the 3 types of mutations. The numbers are large enough for the 1st 2 broods to make it highly probable that the difference between the mutants at specific loci, and the phenotypic dominants is more than just a quantitative difference. In respect to the gonadal periods, it appears that the mutation rate of the Minutes may be considerably higher than of the other types of mutations. It is also suggested that there may be a difference in mutation rates in gonadal cells in different developmental stages at the time of radiation. (NSA 16:1962, 1465)
- 911 Valencia, R.M. SEX RATIO AFTER IRRADIATING FERTILIZED EGGS. Drosophila Inf. Serv. 36 (1962) 126.

- 912 Whiting, A.R. X-RAY INDUCED VISIBLE MUTATIONS IN Habrobracon OÖCYTES. Genetics 48 (1963) 491-5.
- Dominant lethal, recessive lethal, and visible mutations occur in similar percentages in primary oöcytes of Habrobracon x-rayed in a resistant stage, first meiotic prophase ($LD_{50} = 12000$ r), and in a sensitive stage, first meiotic metaphase ($LD_{50} = 400$ r), after comparable doses, 25000 r and 1100 r respectively. (Auth.)
- 913 Whittinghill, M. STUDIES OF MUTATION AND OF RECOMBINATION IN THE SAME CHROMOSOMES OF IRRADIATED FEMALE Drosophila melanogaster. Final Report, Feb. 1, 1954-March 31, 1963. TID-18855, North Carolina. Univ., Chapel Hill. 1963. 34p.
- The frequency of new lethal mutations was measured in chromosomes from isogenic sources which marked the whole length of the second chromosome pair of Drosophila melanogaster for the detection of crossovers simultaneously. Control heterozygotes and sisters given x-ray doses of 3866 or 4580 r provided chromosomes tested by the Sifter technique of Müller. Thereafter, each recessive lethal was further tested to determine the location of the new lethal, particularly as to whether it was in a region of crossing over or was outside any nearby region of exchange. In the chromosomes of eggs laid in the 1st 10 d post-irradiation the frequency of new recessive lethals decreased from a high of $9.8 \pm 1.11\%$ in the 1st 4-d period to $4.7 \pm 0.74\%$ in the last 3-d period. These same chromosomes showed an increase in cross-over chromosomes available for testing, but only during the 2nd and 3rd breeding periods. Neither the cross-overs nor the lethals were linearly related to dose. Four fifths of the higher dose received during 4/5 of the maximum time of treatment produced less than 4/5 of the crossover frequency and of the lethal frequency of the 4580 r group. In spite of the 2 parameters changing in different directions with time the contingency Chi square showed an excess of chromosomes both lethal and crossover in the same region only in the spindle region and in a mid arm region. Studies were made of the mean viability and of its variability among the many non-lethals and lethals of the experiment. Viability was less after either of the irradiation doses. Variability was greater, as expected, among irradiated chromosomes and among crossover chromosomes. The immediate vicinity of the spindle attachment is evidently a very special region of the chromosome in regard to its responses to externally administered irradiation. (auth.)
- 914 Wild, A. A RED EYE COLOUR MUTATION IN Culex pipiens AFTER X-IRRADIATION. Nature, Lond. 200 (1963) 917-8.
- Four 1-2-d-old males of C. pipiens were irradiated with a dose of 4000 r x-rays. While the normal eyes of the larvae, pupae, and adults appear pigmented dark brown to black, the mutation r causes a red eye colour in place of black. This mutant was isolated from F_2 cultures of 2 of the irradiated males. It could be demonstrated that r is inherited as a recessive, shows full penetrance and no variability of expression. Although white-eyed mutation is also sex-linked the two factors could be shown not to be multiple alleles.
- 915* Yamada, Y., Kitagawa, O. DOUBLING RADIATION DOSE IN GENETICS. Kokuritu Idengaku Kenkyujo Nempo 10 (1960) 104.
- After giving 500, 1000, and 1500 r to Drosophila the induced mutation rate was calculated from the regression. The estimation was $8.7 \times 10^{-7}/r$ for the number of abdominal hair, and $3.5 \times 10^{-6}/r$ for the number of chest hair. The doubling doses were estimated as 60 r for the former and 30 r for the latter. (Abstr. Japan Med. 2: (May 1962) No. 5)
- 916 Yamada, Y., Kitagawa, O. DOUBLING DOSE FOR POLYGENIC MUTATIONS IN Drosophila melanogaster. Jap. J. Genet. 36 (1961) 76-83. (In English)
- Effects of x-irradiation upon bristle numbers in Drosophila were remarkable for increasing variances but no increase or decrease was observed for the means. This suggests that the chaeta characters in Drosophila are controlled by neutral genes and the cause of variance increase must be due to induced polygenic mutations. The doubling doses for polygenes involving the chaeta characters were estimated by the two different methods, i.e., isogenisation and selection. They are estimated to be 58 r and 29 r respectively for abdominal and sternopleural bristle numbers from the isogenisation experiment and to be 18 r on an average from selection experiments, providing the spontaneous variance increase rates of the traits be 0.005 and 0.001 per generation, respectively. (Auth.)

See also:

- 471 Effects of irradiation on the Mediterranean meal moth Ephestia kuehniella Zeller, cultured on Sr⁹⁰-spiked food. (Erdman, 1962)
- 474 A non-random distribution of lethals induced by tritiated thymidine in Drosophila melanogaster. (Kaplan et al., 1962)
- 475 The genetic effects of labelled DNA precursors. (Kaplan et al., 1963)
- 477 Mutagenic effect of C¹⁴ and H³ labelled DNA precursors injected into Drosophila melanogaster males. (Strömme, 1962)
- 478 The induction of minute mutations in Drosophila with tritium-labelled thymidine. (Strömme and Kveiland, 1963)
- 479 Cytogenetic studies of x-ray and ingested P³² induced sex-linked recessive lethals in Drosophila melanogaster. (Walen, 1962)
- 758 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1959)
- 759 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1960)
- 760 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1961)
- 770 The induction of mutations in spermatocytes of Drosophila melanogaster with x-rays. (Chandley, 1962)
- 775 Irradiated parasitic wasps, the effect on progeny production and sex ratio. (De Bach and White, 1963)
- 793 Sperm transfer, storage, displacement, and utilization in Drosophila melanogaster. (Lefevre and Jonsson, 1962)
- 800 Induction of mutations and cell killing in irradiated Drosophila spermatogonia. (Ofstedal, 1963)
- 801 Genetic sensitivity and differential killing in irradiated Drosophila spermatogonia. (Ofstedal, 1963)
- 802 Induction of mutations and killing of cells in irradiated spermatogonia of Drosophila. (Ofstedal, 1963)
- 807 Some effects of gamma radiation on the reproductive potential of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962)
- 814 Studies on the genetic effect of radiation 1959-1960. II: Studies on the genetic effect of radiation with silkworm. (1) Differences between times of death of the F₁ after irradiation of oögonia or mature oöcytes. (Tazima and Onimaru, 1962)
- 819 R-locus factor homologies in Mormoniella. (Whiting, 1962)
- 919 Genetic recovery mechanisms and fast neutron treatment of mature sperm treated in males and fertilized females of D. melanogaster. (Alexander, 1961)
- 923 The rates of translocations and recessive lethals of chromosome IV of Drosophila melanogaster after x-ray treatment. (Belitz, 1963)
- 926 Radiation analysis of a lecanoid genetic system. (Brown and Nelson-Rees, 1961)
- 940 Mutation rates at specific autosomal loci in different species of Drosophila. (Hannah-Alava, 1963)
- 941 Induced changes in female germ cells of Drosophila. VIII. Exchanges induced in different X chromosome regions after x-raying oöcytes and oögonia. (Herskowitz et al., 1962)
- 944 Spontaneous and radiation mutagenesis and mutability in Drosophila. (Herskowitz, 1963)
- 969 The brood pattern of x-ray induced crossing-overs in Drosophila melanogaster males. (Puro, 1963)
- 1000 Mutagenic sensitivity of sperm, spermatids, spermatocytes, and spermatogonia in Drosophila melanogaster. (Chandley and Bartman, 1961)
- 1005 Patterns of spontaneous and radiation induced mutation rates during spermatogenesis in Drosophila melanogaster. (Ives, 1963)
- 1006 Radiosensitivity in different stages of spermatogenesis in Drosophila melanogaster. (Kveiland, 1962)
- 1010 On the nature of sensitivity changes in oöcytes of Drosophila melanogaster. (Parker, 1963)
- 1014 A comparison of mutation rates in male and female pre- and postmeiotic germ cells of Drosophila. (Ratty, 1961)
- 1023 Radiosensitivity during spermatogenesis in Drosophila melanogaster. (Strangio, 1962)
- 1024 Considerations on the changes in observed mutation rates in the silkworm after irradiation of various stages of gametogenesis. (Tazima, 1961)
- 1029 A comparison of visible mutation rates in Habrobracon eggs x-rayed in first meiotic metaphase or prophase. (Whiting, 1962)
- 1034 Dependence of the frequency of occurrence of recessive sex-linked lethal mutations in Drosophila spermatogenesis on the fast-neutron dose. (Abeleva and Lapkin, 1963)

- 1042 Radiation sensitivity in sperm treated in males and inseminated females of Drosophila with x-rays in nitrogen and air. (Alexander and Bergendahl, 1962)
- 1049 The effects of nitric oxide on radiation damage in Drosophila virilis and Drosophila melanogaster. (Capps, 1961)
- 1052 Reduction of the sex-linked recessive lethal frequencies in Drosophila melanogaster by argon, nitrogen, and methane under pressure. (Chang, 1960)
- 1053 Further observations on the relation between gas pressure and the x-ray damage in Drosophila melanogaster. (Chang, 1962)
- 1054 The effects of chloramphenicol, streptomycin and penicillin on the induction of mutations by x-rays in Drosophila melanogaster. (Clark 1963).
- 1058 Nitrogen-treatment effects on rearrangement-induction patterns in Drosophila melanogaster. (Falk, 1961/2)
- 1059 Modification of the radio-induced mutability in Drosophila by 2,4-dinitrophenol. (Fritz-Niggli, 1961)
- 1060 Preliminary results of combined effects of oxygen and low temperatures on mutations induced by x-rays in Drosophila. (Gavelli et al., 1963)
- 1063 Effect of fractionating doses on the rate of x-ray-induced mutations in Drosophila. (Guyenot et al., 1961)
- 1064 Study on the effect of amino-ethylisothioniumchloride-hydrochloride (AET) on radiation-induced mutation rate in Drosophila melanogaster. (Henke et al., 1963)
- 1065 The oxygen effect in irradiated mature and meiotic germ cells of Drosophila melanogaster. (Hoenigsberg et al., 1961)
- 1066 The effects of developmental temperature on mutational response to gamma rays in Drosophila spermatogenesis. (Ives, 1962)
- 1078 On a change in the spectrum of somatic mutations in Ephestia kuehniella Z. by temperature treatment before irradiation. (Lobbecke, and Oltmanns, 1961)
- 1085 Oxygen-effect on mutation-rate induced in different stages of spermiogenesis in Drosophila melanogaster by 31-MeV electrons and 180-kV x-rays.
- 1087 Differential yields of mutations from the first and second matings after irradiation of mature sperm in Drosophila melanogaster. (Mossige, 1963)
- 1088 Changes in the mutational spectrum of somatic mutations in Ephestia by pre-treatment with low and high temperatures. (Müller, 1962)
- 1089 Are chronic and acute gamma irradiation equally mutagenic in Drosophila? (Müller et al., 1963)
- 1092 Effects of variable dose-rates on radiation damage in the rust-red flour beetle, Tribolium castaneum Herbst. (Nair and Subramanyam, 1963)
- 1094 Interaction of x-and ultraviolet radiation in production of recessive lethals in Drosophila melanogaster. (Nicolletti and Olivieri, 1962)
- 1097 The frequency of mosaic mutations induced by gamma rays and neutrons. (Oster et al., 1963)
- 1098 The mutational spectrum with special reference to the induction of mosaics. (Oster, 1963)
- 1102 Preliminary report on the effect of cysteine on the rate of x-ray induced mutations in Drosophila melanogaster. (Paik, et al., 1962)
- 1107 The effect of x-ray treatment combined with air, nitrogen, or oxygen in Drosophila melanogaster studied on sex-linked recessive lethals. (Pozzi et al., 1962)
- 1108 Differential sensitivity of spermatogenic stages of Drosophila melanogaster to x-ray irradiation in O₂ and N₂. (Pozzi et al., 1962)
- 1110 Dose-rate and the induction of mutation in Drosophila. (Purdom and McSheehy, 1963)
- 1111 Radiation intensity and the induction of mutation in Drosophila. (Purdom and McSheehy, 1963)
- 1115 The genetical response of radiation spermatozoa to different types of radiation treatment. (Reddi, 1963)
- 1125 Protective action of penicillin against mutagenic effect of x-rays in Drosophila. (Shiomi and Tachibana, 1962)
- 1126 Effect of penicillin feeding on the reduction of radiation induced mutation rate in Drosophila melanogaster. (Shiomi, 1963)
- 1136 Repair and differential radiosensitivity in developing germ cells of Drosophila males. (Sobeis, 1963)
- 1141 Modification of genetic radiation damage in Drosophila by post-treatment with nitrogen and fractionation of the dose. (Tates and Sobels, 1961)
- 1142 Modification of the x-ray induced rate of sex-linked lethals by nitrogen post-treatment and fractionation of the dose in Drosophila melanogaster. (Tates, 1963)
- 1150 Dose-dependence of radiation-induced mutation rate in Drosophila melanogaster depending on the stage sensitivity of the irradiated germ cells. (Traut, 1962)

1151. A study of dose-dependence of radiation-induced mutation rates in Drosophila melanogaster, allowing for the degree of maturity of the germ cells. (Traut, 1962)
1152. Dose dependence of the frequency of radiation induced recessive sex-linked lethals in Drosophila melanogaster. (Traut, 1963)
1153. Dose-dependence of the frequency of radiation-induced recessive sex-linked lethals in Drosophila melanogaster, with special consideration of the stage sensitivity of the irradiated germ cells. (Traut, 1963)
1154. The relationship between dosage and mutation rate in x-radiation of Drosophila zygotes. (Ulrich, 1960)
1156. Partial irradiation of Drosophila zygotes by x-rays. (Ulrich, 1963)
1167. The correlation of the ratio of lethal to visible mutations with that of whole-body to fractionals induced by x-rays and chemical mutagens. (Browning and Altenburg, 1961)
1168. Gonadal mosaicism as a factor in determining the ratio of visible to lethal mutations in Drosophila. (Browning and Altenburg, 1961)
1170. Comparative mutagenesis of the dumpy locus in Drosophila melanogaster. II. Mutational mosaicism induced without apparent breakage by a monofunctional alkylating agent. (Carlson and Oster, 1962)
1171. Somatic mutations in the moth Ephesia. (Caspari, 1962)
1175. Mutational response of Habrobracon oöcytes in metaphase and prophase to ethyl methanesulfonate and nitrogen mustard. (Löbbecke and Borstel, 1962)
1179. Rates of forward and reverse mutation in Drosophila after exposure to mustard gas and x-rays. (Sobels, 1962)
1215. Irradiation experiments with Tribolium. (Sokoloff, 1961)
1218. Genetic studies of Drosophila strain differences in sensitivity of the testis to the mutagenic action of x-rays. (Ward et al., 1962)
1231. Prepupal effects of x-ray-induced, euploid and near-euploid mutants in heterozygous condition in Drosophila melanogaster. (Baumiller, 1961)
1232. The effects of x-ray induced euploid and near-euploid mutants in heterozygous condition upon developmental stages of Drosophila melanogaster. (Baumiller, 1962)
1233. Developmental effects of x-ray induced euploid and near-euploid mutants in heterozygous condition in Drosophila melanogaster. I. Delay in egg hatching and larval delay and death prior to pupation. (Baumiller, 1963)
1271. The influence of age and mating patterns before and after irradiation on the incidence of induced mutations in Drosophila melanogaster. (Lefevre, 1963)
1296. X-ray sensitivity of spermatogonia and spermatozoa in Drosophila melanogaster. (Ytterborn, 1962)
1369. Oxygen dependence of the lethal and mutation rates induced by x-irradiation of Drosophila zygotes (Würgler, 1960)
1374. Reactions to x-rays of a normal and a HCN-unsusceptible stock of Drosophila melanogaster. (Lüters, 1963)
1381. A comparative study between natural lethals and lethals induced by radiation in populations of Drosophila willistoni. (Pavaa, 1963)
1392. Relative genetic loads due to lethal and detrimental genes in irradiated populations of Drosophila melanogaster. (Chung, 1962)
1397. Persistence of lethals in irradiated natural populations of Drosophila willistoni. (Marques et al., 1963)
1401. Heterozygous effects of induced lethal genes on pre-adult viability in Drosophila melanogaster and their persistence in experimental populations. (Oshima and Kitagawa, 1961)
1404. Mutational recurrence or genetic compensation of lethals in Drosophila natural and irradiated populations? (Reguly and Cordeiro, 1963)
1405. Genetical effects of radiation: a comparative study between natural lethals and lethals induced by radiation in population of Drosophila willistoni. (São Paulo, Brazil, Universidade. Faculdade de Filosofia, Ciências e Letras, 1963)
1408. Experiments on mutation processes in populations. (Toropanova, 1962)
- 1411-2 The investigation of the genetic structure of populations. (Wallace, 1961, 1963)
1477. Control of insect populations through genetic manipulations. (LaChance and Knippling, 1962)

I-A-4 CHROMOSOME ABERRATIONS
(BREAKS. CROSSING-OVER. TRANSLOCATIONS. Etc.)

General

- 917 Abbadessa, R., Burdick, A.E. THE EFFECT OF X-IRRADIATION ON SOMATIC CROSSING OVER IN Drosophila melanogaster. Genetics 48, 10 (1963) 1345-56.
- Four different genotypes of D. melanogaster were x-irradiated at 1350 r during the 1st, 2nd, and 3rd larval instars. Treatment with x-rays resulted in a 3-fold increase in the frequency of somatic crossing over, evidenced by incidence of abdominal mosaicism. This effect was influenced by genotype and the ontogenetic time at which irradiation occurred. No mosaic spots were detected in the wings, even after irradiation. It is concluded that if somatic crossing over occurs in the wing anlage, it does so at an extremely low frequency. (Auth. summary)
- 917-a Evans, H.J. CHROMOSOME ABERRATIONS INDUCED BY IONIZING RADIATIONS. Int. Rev. Cytol. 13 (1962) 221-308.
- Detailed review article concerned with a great variety of biological material, and divided into sections dealing with chromosome and chromatid type aberrations; general theory of aberration production; the exchange hypothesis; chromosome stickiness and sub-chromatid aberrations; the relation between aberration structure and the mitotic and meiotic cycles; relative radiosensitivity of different organisms, cell types, and stages in cell development; factors affecting the distribution of aberrations within and between nuclei and chromosomes; the relative efficiencies of different ionizing radiations; the oxygen effect and the importance of oxidative processes in aberration production; and other physical and chemical factors modifying aberration frequencies. Results obtained from studies on insects are also included. More than 500 references are cited.
- 918 Abrahamson, S. CHROMOSOME REARRANGEMENTS INDUCED BY X-RAYS IN IMMATURE GERM CELLS OF Drosophila. Nature, Lond. 181 (1961) 523-4.
- Factors influencing the production of chromosome rearrangements by x-rays in early oocytes and oögonia of Drosophila melanogaster, are investigated, amongst them anoxia, fractionation of treatments, age of females at irradiation, etc. The results are discussed. Data on the frequency of detachments of attached-X chromosomes produced by different modes of treatment are tabulated.
- 919 Alexander, M.L. GENETIC RECOVERY MECHANISMS AND FAST NEUTRON TREATMENT OF MATURE SPERM TREATED IN MALES AND FERTILIZED FEMALES OF D. melanogaster. (Abstr.) Genetics 46, 8 (1961) 846.
- Fast neutrons of an average of 2 MeV energies were utilized to test for increases in sensitivity in mature sperm after female insemination. Mature males and inseminated females were treated with 900 rads of neutrons. Males were mated to Muller-5 females or bw st females and the 1st and 2nd day's tested separately. Sex-linked lethals were scored by the Muller-5 method and translocations tested with bw st. — The results for sex-linked lethals induced in sperm treated in inseminated females were 5.5% (5/90) for the 1st day and 8.3% (51/611) for the 2nd. For treated males, the percentages of lethals were: 1st day 5.4% (40/735) and the 2nd day 3.5% (17/488). — For translocations in the female test, 9.8% (47/479) were obtained for the 1st day and 9.5% (59/623) for the 2nd. For treated males, 5.2% (33/629) were found for the 1st day and 7.8% (43/552) for the second day. By treating males with 1500 rads of neutrons, translocation values of 14.1% (30/212) were observed for the 1st day and 11.8% (22/211) for the 2nd day. Chi-square values were not significant for the 1st and 2nd day comparisons. — The absence of significant or consistent changes in genetic damage in the 2nd day as compared to the first indicates the absence of recovery mechanisms after neutron treatment. Combined values for both days were significantly higher in the female than in the male tests. This increase in genetic damage after sperm insemination shows greater chromosome sensitivity to breakage since recovery mechanisms were not observed and will not explain the increase.
- 920 Alexander, M.L. DETECTION AND SEPARATION OF SPONTANEOUS AND INDUCED TRANSLOCATIONS IN MATURE AND IMMATURE GERM CELLS OF Drosophila. Amer. Nat. 96 (1962) 309-15.
- Translocations of spontaneous origin were detected from unirradiated females in certain strains of D. virilis. Results for the spontaneous translocations were similar in appearance to the expected results if clusters of

translocations were recovered from irradiated spermatogonia of males. Additional testing was necessary to separate spontaneous translocations originating in females from induced translocations in males. The method of separation is also applicable to separation of induced translocations of maternal and paternal origin when inseminated females are irradiated. Spontaneous translocations in females involved different chromosomes and therefore offer an evolutionary source of genetic variability of translocations. (NSA 17: 1963, 12138)

- 921 Bateman, A.J., Chandley, A.C. AN ANALYSIS OF X-RAY INDUCED NON-DISJUNCTION IN Drosophila. (Abstr. 5.41) p.69 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

It is common to distinguish between two forms of meiotic non-disjunction: at first and second division respectively. This is a gross simplification. There are many possible mechanisms resulting in non-disjunction. Some of them are recognisable by their genetic effects. An analysis of matriclinous females in Drosophila, produced by x-rays, has been made in an attempt to determine which modes of non-disjunction are, in fact, operating in their production. Though the results are ambiguous, some definite conclusions can be drawn.

- 922 Bateman, A.J., Chandley, A.C. THE EFFECTS OF X-RAYS ON CROSSING-OVER IN Drosophila melanogaster. (Abstr.) Heredity 18, 1 (1963) 125.

The effect of x-rays in doses from 1000 to 8000 rads on crossing-over between the X-chromosomes of the female was studied, using the markers sc, ec, cv, ct, v, g, f and car. X-rays produced little or no effect on crossing-over in eggs laid during the first 5 d after treatment but produced a strong depression of crossing-over from day 6 onwards, which was maximal on days 7 and 8. Analysis of the individual segments revealed that the regions most sensitive to this depression were those furthest from the centromere. The segments nearest to the centromere actually showed a significant increase in crossing-over, with a maximum effect at 4000 rads. (From abstr.)

- 923 Belitz, H.J. THE RATES OF TRANSLOCATIONS AND RECESSIVE LETHALS OF CHROMOSOME IV OF Drosophila melanogaster AFTER X-RAY TREATMENT. (Abstr.) Int. J. Rad. Biol. 8, 4 (1963) 378.

For the detection of translocations Drosophila males, 1-2 d old, of the stock Berlin-wild were irradiated (100 kV; 1.7 mm Al) and mated each with one homozygous ci ey female. In intervals of 3 d each male was repeatedly mated with a fresh virgin female. In this way 5 broods were won. All ci-animals of the F_1 were tested with a special stock to prove the translocation character. In the broods I-IV (ripe spermspermatocytes) the translocation rates increase with dose. They are in a good agreement with dose-effect curves increasing with an exponent of 3/2 dose. The relative values of the rates of all dosages in these broods are: brood I=1.0; II=2.6; III=4.9; IV=1.0 showing a clear brood pattern. The corresponding values for sex-linked recessive lethals from experiments with the same wild stock under the same conditions for 3 broods are: brood I=1.0; II=1.3; III=1.1. For the recessive lethals of chromosome IV we have found at 3.0 kr: brood I: $3/917 = 0.33\%$; II: $8/713 = 1.12\%$; III: $1/317 = 0.32\%$. In both cases the maximum for recessive lethals lies in brood II. So the results show different brood patterns for translocations and recessive lethals, respectively. In brood V (late spermatogonia during irradiation) in the translocation experiments the experimental findings are: 1.5 kr: $6/8571 = 0.11\%$; 3.0 kr: $7/7780 = 0.09\%$; 4.5 kr: $3/6425 = 0.05\%$; 6.0 kr: $4/4982 = 0.08\%$. It is not possible to construct a dose-effect curve of the type mentioned above which is in agreement with these values. It seems reasonable to construct a dose-effect curve going through the point for 1.5 kr. Then the low mutation rates at higher doses may be explained by germinal selection, i.e. all chromosome fragments which have not undergone a recombination or restitution before the next division are eliminated. Subtraction of the experimentally determined mutation rate from the estimated curve gives a curve for the action of germinal selection running parallel to the theoretical dose effect curve in the investigated dose range. First results concerning recessive lethals of chromosome IV in this brood show an increase of this type of mutations in late spermatogonia (3.0 kr: $2/824 = 0.24\%$; 4.5 kr: $1/225 = 0.44\%$) indicating that recessive lethals are not affected by this kind of germinal selection. (From abstr.)

- 924 Brosseau, G.E., Jr., Nicoletti, B., Grell, E.H., Lindsley, D.L. PRODUCTION OF ALTERED Y CHROMOSOMES BEARING SPECIFIC SECTIONS OF THE X CHROMOSOME IN Drosophila. Genetics 46, 3 (1961) 339-46.

A method for producing marked Y chromosomes by irradiating reciprocal translocations between an XY chromosome and some other element in the genome has been used and a series of marked Y's recovered.

The most useful markers that have been appended to a Y are BS, w⁺ and N⁺, and ma-1⁺. In addition to these Y's, which carry single marker segments, a number of doubly marked Y's have been constructed. The current best estimate of the constitutions of the known marked Y chromosomes are tabulated. (Auth. summary)

- 925 Brosseau, G.E., Jr. NON RANDOM RECOVERY OF DETACHMENTS FROM AN ATTACHED-X CHROMOSOME IN *Drosophila*. (Abstr.) *Genetics* 46, 8 (1961) 854.
- Irradiation of females of the constitution $y^1 su-w^a w^{ab} b: = /BSY y^+$ with 990 r of x-rays yielded 159 detachments. Of these 57 carried BS, 58 were y⁺, 32 carried neither marker and 12 were sterile or were lost before testing was completed. The detachments that carried neither marker were tested further for evidence of involvement of the Y in the exchange and none was found. These are probably autosomal detachments and were not tested further. The remainder of the detachments were tested to determine the location of the Y break with respect to bb⁺ and the fertility factors. Complementary detachments were recovered in very unequal numbers. The exchange resulting in a detachment produces an asymmetric dyad from which the shortest element is recovered more frequently. This is similar to those cases in which Novitski (1951) found non random disjunction, and it is likely that this is another case of the same phenomenon. The coefficients of non randomness for 3 classes of detachments are: 0.76, 0.88, 0.71. Fifty-three of the 115 breaks or 46.1% were between the most distal fertility factor of the arm involved and the X-derived terminal marker. Another peak of breakage occurs in the portion of Y^S that is homologous to the X. Perhaps most of the exchanges that produce detachments occur in synapsed homologous regions and detachments with the Y might be induced crossovers rather than translocations.
- 926 Brown, S.W., Nelson-Rees, W.A. RADIATION ANALYSIS OF A LECANOID GENETIC SYSTEM. *Genetics* 46, 8 (1961) 983-1007.
- In the lecanoid chromosomal system, as exemplified by the mealy bug, *Planococcus citri* (Risso), one chromosome set becomes heterochromatic during embryogeny of the male and is maintained as such during development. At spermatogenesis, the first division is equational for both the euchromatic and heterochromatic chromosomes which are segregated from each other in the second; only the euchromatic derivatives form sperm. Schrader and Hughes-Schrader suggested that the heterochromatic set is genetically inert and Hughes-Schrader suggested that it is of paternal origin. Radiation studies were undertaken to test the Schraders' hypotheses. After paternal irradiation, the induced aberrations appear in the heterochromatic set of the male embryos while they occur in the euchromatic set after maternal treatment. Hughes-Schrader's hypothesis of the paternal origin of the heterochromatic set is therefore confirmed. After maternal treatment, both sexes diminish with increasing dosage but the results are complicated by the effect of maternal age on the sequence in which the two sexes of offspring occur during oviposition (sexual dichromism) as well as on total progeny. (From auth. summary).
- 927 Chandley, A.C., Bateman, A.J. DOSE-DEPENDENCE OF X-RAY INDUCED NON-DISJUNCTION IN *Drosophila melanogaster* FEMALES. (Abstr. 5.42) p.69 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.1". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.
- The frequency of induced non-disjunction in female germ cells has been estimated on eleven successive days following irradiation with x-rays. Doses of 1, 4, 8 and 8 k rad have been used and the results indicate a non-linear dose-dependence both for female (XXY) and male (XO) exceptions. Over the first 6 d, the frequency appears to increase with the square of the dose. In spite of the frequency of male exceptions being 4-5 times as great as that of the female exceptions, the shapes of the dose-dependence curves are closely similar. After day 6, when the female and male exceptions have equal incidences, the dose-dependence departs even further from linearity.
- 928 Chandra, H.S. CYTOGENETIC STUDIES FOLLOWING HIGH DOSAGE PATERNAL IRRADIATION IN THE MEALY BUG, *Planococcus citri* (Risso). Thesis. California, Univ., Berkeley, 1962.
- 929 Chandra, H.S. CYTOGENETIC STUDIES FOLLOWING HIGH DOSAGE PATERNAL IRRADIATION IN THE MEALY BUG, *Planococcus citri*. I. CYTOLOGY OF X₁ EMBRYOS. *Chromosoma* 14 (1963) 310-29.
- In the mealy bug, *Planococcus citri*, following high dosage paternal irradiation (60 000 to 120 000 rep), the survivors are mostly female (about 30 to 40% of the unirradiated control value) whereas very few males survive (about 5% of control value). After lower doses of paternal irradiation (P.I.), however, few or no females survive while the normal number of males (never less than the control value) survive.

The females developing after high dosage P.I. are gynogenetic and are triploid or diploid or 3N/2N or 2N/N mosaics. The cytology of X_1 embryos following 90 000 rep is described in comparison with data from embryos following lower doses (8000 r) of P.I. and unirradiated controls, to illustrate the chromosomal mechanisms leading to the production of gynogenetic females and the probable reasons for lethality of X_1 males after heavy P.I. It has been shown that triploid females stem from a fusion nucleus of the first and second polar bodies. This triploid polar nucleus, which normally participates in the formation of a polyploid sector in the young embryo, undertakes a successful embryogeny in many embryos when the zygote nucleus is unable to do so because of the heavily damaged paternal complement of chromosomes. Since the chromosomes are characterized by holokinetic activity, the irradiated paternal set manages to divide with the maternal complement but did not always segregate as successfully. Restitution divisions of the zygotic nuclei result in haploid, hyperhaploid, diploid and polyploid nuclei. Most of the diploid gynogenetic females probably originate from diploid nuclei of zygotic origin although it is possible that a few diploid females and the 2N/N mosaic females develop from polar bodies. (Auth.)

- 930 Chandra, H.S. CYTOGENETIC STUDIES FOLLOWING HIGH DOSAGE PATERNAL IRRADIATION IN THE MEALY BUG, *Planococcus citri*. II. CYTOLOGY OF X_1 FEMALES AND THE PROBLEM OF LECANOID SEX DETERMINATION. *Chromosoma* 14 (1963) 330-46.

When females of the mealy bug, *Planococcus citri*, are mated to males previously irradiated with heavy doses of γ -rays (30 000 to 120 000 rep), the progeny is mostly female. These X_1 females are gynogenetic, with unbroken chromosomes. Detailed cytology of 17 such gynogenetic females showed triploids, diploids, and 3N/2N and 2N/N mosaics. Most of the embryos produced by triploid mothers were aneuploid and these degenerated before gastrulation. Regardless of aneuploidy, male embryos showed the typical lecanoid heterochromatization of the paternal set of chromosomes. Just prior to degeneration, the euchromatic chromosomes in the aneuploid male embryos showed endomitotic splitting while the heterochromatic did not. Among the progeny of 3N♀x2N♂ matings, only males with 5 euchromatic +5 heterochromatic chromosomes and females with 10 or 15 euchromatic chromosomes were found. A search for adults with 5 heterochromatic +10 euchromatic chromosomes among the progeny of triploid mothers was unsuccessful. Chromosomal variables such as aneuploidy of the euchromatic set, haploidy and fragmentation are discussed in relation to the problems of heterochromatization of the paternal set and sex determination in this species. (Auth.)

- 931 Chovnick, A., Schalet, A., Kernaghan, R.P. RECOMBINATION AT THE ROSY LOCUS IN *Drosophila melanogaster*. (Abstr.) *Genetics* 46, 8 (1961) 858-9.

A series of spontaneous and x-ray-induced mutants at the rosy locus (3-52.4) were subjected to recombinational analysis through the use of a crossover-selector system (Whittinghill 1950). Males from a balanced stock, In(3) MRS, M34 ry^2 Sb/Dfd ry^2 Ubx e^A , were mated to two series of females: (A) M34 Dfd $ry^{++} / ++ry^2$ Sb Ubx and (B) M34 dfd $ry^2 / ++ry^2$ Sb Ubx. Due to homozygous lethality associated with the markers M34, Dfd, Sb, and Ubx, all offspring of these crosses die except 1/4 of the crossovers between M34 and Dfd, 1/4 of the crossovers between Sb and Ubx, and 1/2 of the crossovers between Dfd and Sb. Viable offspring represent only 5% of all zygotes. The remaining 95% die as larvae or pupae. From a set of such crosses most adult offspring are phenotypically rosy. The sporadic ry^+ individuals consistently found in one of the two crosses in a set invariably carry appropriate markers indicating their origin as crossovers between separable sites within a complex locus. The double mutant types, expected in the cross that does not yield ry^+ individuals, have not been distinguished. Three separable sites within the rosy locus have been established: (ry^1 , ry^4 , ry^5 , ry^6) - ry^{28} - (ry^2 , ry^3 , ry^7). Significant failure of recombination has not been observed. Map distances, estimated as $2X(\% \text{ of } ry^+ \text{ recombinants}) \times 100/200 \times (\text{total surviving offspring})$, range from a high of 0.008 to a low of 0.0004. An improved selective system with increased percent killing and some egg mortality has replaced the above system in current experiments. - All mutants reported here are noncomplementary for eye colour and xanthine dehydrogenase activity. Current data support the existence of a single complementation group.

- 932 Crow, J.F., Thomas, C., Sandler, L. EVIDENCE THAT SEGREGATION-DISTORTION PHENOMENON IN *Drosophila* INVOLVES CHROMOSOME BREAKAGE. *Proc. nat. Acad. Sci., U.S.* 48 (1962) 1307-14.

When distorting males in the segregation-distorter (SD) strains of *Drosophila* were x-irradiated, they produced a larger fraction of chromosomes showing recombination about the SD region than controls. The SD effect on the homologue was concluded to be a chromosome break because of the ability to rejoin with a radiation-induced break. (A 57: 1962, 17230 f).

Dubinín, N.P., Kanavets, O.L. FACTORS OF COSMIC FLIGHT AND PRIMARY NON-DISJUNCTION OF CHROMOSOMES. p.350-8 in FTD-MT-82-78, n.d. Translation.

The genetic consequences of non-disjunction of chromosomes are reviewed. Data are presented from an analysis of non-disjunction of sex chromosomes in female *Drosophila* subjected to space flight. Results are compared with data on female *Drosophila* exposed to x-radiation or to the conditions encountered during space flight with the exception of radiation exposure. Space flight caused more primary non-disjunctions, and the genetic effects were evident for longer periods of time than either of the other conditions tested. (NSA 17:1963, 35283)

Fabergé, A.C., Judd, B.H. CHROMOSOME BREAKS BY ALPHA PARTICLES. *Drosophila Inf. Serv.* 35 (1961) 79-80.

Frye, S.H. CONCERNING THE X-RAY DOSE-FREQUENCY RELATION FOR MINUTE CHROMOSOME CHANGES IN THE YELLOW REGION IN *Drosophila melanogaster*. (Abstr.) *Genetics* 47, 8 (1962) 953.

Totals of yellow mutants, x-ray-induced in y^+ scute-8 chromosomes of mature and nearly mature sperm (ejaculated 0-2 and 2-4 d after irradiation), were found to exhibit approximately a linear dose-frequency relation. The presence or absence (inactivation) of markers closely linked to yellow was determined by genetic analyses of 98% of the 558 yellows that were able to breed and were transmitted. Intergenic or "breakage" yellows accounted for 96-98% of the transmissible yellows and these were roughly classified into "only minute" and "gross" chromosome changes. - The induced frequencies of "only minutes" varied significantly below linearity with dose, whereas those of "gross changes" varied significantly above linearity. Hence, the linear dose-frequency relation of total yellow mutants is complex and consists of at least three presumptive components: sublinear, linear, and supralinear. Dose frequencies of the "only minutes" did not disagree significantly with that expected were they proportional to the 0.8 dose power. However, dose frequencies of total minutes accorded satisfactorily with the theoretical expectation of linearity if the total minutes included those gross yellows "capped" by a translocated autosomal end piece and other simultaneous gross and minute yellow changes lost by aneuploidy. Availability of a more accurate criterion of minute versus gross than the determination of which side of bb^+ the right-hand break lay on would have yielded more homogeneous classes and sharper dose-frequency relations. The dose-frequency criterion is more likely to be meaningful where heterogeneities, such as germ cell treated, structure of the mutants, and others are minimal.

Frye, S.H. A STUDY OF MINUTE STRUCTURAL CHANGES OF CHROMOSOMES IN *Drosophila*. *Diss. Abstr.* 24, 1 (1963) 443-4.

The problem of minute chromosome change was reinvestigated by studying the frequency-dose relation of changes of the yellow locus in scute-8 chromosomes of mature and nearly mature sperm (ejaculated from 0-2 and 2-4 d after irradiation) in relation to 4 x-ray doses. The frequencies at which 607 exceptional yellow females occurred in relation to x-ray dose can be represented by a linear equation. Genetic analysis in order to determine the presence or "absence" (inactivation) of markers closely linked to the yellow locus were conducted on 98% of all yellows able to breed and be transmitted. After analysis and subsection to various structural and/or phenotypic criteria, the yellows were classified into 2 categories. Extragenic or breakage yellows accounted for 96-98%; presumptive intragenic or non-breakage yellows for 4-2%. It was deduced from the frequency-dose curves that many of the two breaks, produced close together, were produced in the course of a single ionizing particle, whereas many of the two (or more) breaks, produced far apart, in the course of 2 separate ionizing particles. Two serious sources of heterogeneity are discussed: changes of sensitivity within short periods during spermatogenesis, and structural heterogeneity of the most common groups classified as "minute" changes. The linear relation found between yellow mutants of all classes taken together and x-ray dose is complex in its details. This complexity is discussed further.

Goldschmidt, E., Barak, E., Bernstein, N., Falk, R. THE RESTITUTION OF RADIATION INDUCED BREAKS IN STRUCTURAL HETEROZYGOTES OF *Drosophila*. (Abstr. 5.49) p.72 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.1". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

Males of *D. melanogaster* carrying the Cy (II L) inversion and their structurally homozygous brothers were given an x-ray dose of 5000 r. The salivary glands were scanned in larval offspring of both groups of males, and all breaks induced in euchromatic sections of the entire chromosome set were located. The rate of induced aberrations was higher in the F_2 produced by Cy fathers. The hatchability of eggs fertilized

by irradiated males of both groups was studied in order to compare the brood patterns and the overall rates of "dominant lethals" induced during the premeiotic stages up to the first meiotic anaphase. It has been suggested that the loop configuration in the heterozygous bivalent facilitates non-homologous contact and thus promotes abnormal restitution. A more comprehensive hypothesis proposes that each of two perfectly synapsed homologues provides a "splint" for the normal restitution of its partner. Hence *asynapsis per se* will interfere with the normal repair of breaks. On this assumption the structural heterozygosity of one bivalent, promoting asynapsis in non-homologous elements, may be responsible for the increased production of abnormal restitutions in the entire chromosome set.

- 938 Gottlieb, F.J., THE CONTROL OF BRISTLE PATTERN BY HAIRY-WING IN Drosophila melanogaster. Diss. Abstr. 24, 3 (1983) 941.

An analysis of the control of developmental patterns exercised by the mutant gene Hairy-wing 49c was undertaken. This gene, in addition to causing the formation of chaetae on the wing veins, controls the formation of extra macro- and microchaetae on the thorax. In homozygous condition it causes the thorax to be disproportionately wider at the level of the dorsocentral region and controls the formation of numerous extra microchaetae in the dorsocentral region. The number of rows of achrostichal chaetae is greatly increased and numerous extra macrochaetae are present. The heterozygote does not show this disproportionate increase in width and, while it has an increase in the number of achrostichal rows, does not show any significant increase in microchaeta density in the dorsocentral region, and possesses fewer extra macrochaetae than the homozygote. By means of genetic mosaics, produced by inducing somatic crossing-over in heterozygous larvae with x-irradiation, a developmental analysis of the differences in differentiation in the tissues of the Hairy-wing homozygous genotypes were performed. X-irradiation causes Hairy-wing heterozygotes to express themselves in a homozygouslike fashion.

- 939 Grell, E.H. THE DOSE EFFECT OF ma-1⁺ and ry⁺ ON XANTHINE DEHYDROGENASE ACTIVITY IN Drosophila melanogaster. Z. VererbLehre 93 (1962) 371-7.

Two loci, ma-1⁺ and ry⁺, necessary for xanthine dehydrogenase activity were studied for dosage effects utilizing deficiencies and duplications induced for this purpose. Rather than assume that the known ma-1 and ry mutations are deficient for all gene activity, true chromosomal deficiencies were produced by x-irradiation. Comparisons of 1, 2 and 3 doses of ma-1⁺ in the female or 1 and 2 doses in the male indicate that there is no increase in specific enzyme activity with dose. On the other hand, comparisons of 1, 2 and 3 doses of ry⁺ in the male and female reveal an increase in enzyme activity that is roughly proportional to dose. Since dosage of ry⁺ is limiting, whereas that of ma-1⁺ is not, the final concentration of xanthine dehydrogenase is shown to depend on the number of doses of ry⁺. The implications of these findings with respect to the hypothesis of dosage compensation and to the mechanism of control of enzyme and protein concentration are discussed.

- 940 Hannah-Alava, A. MUTATION RATES AT SPECIFIC AUTOSOMAL LOCI IN DIFFERENT SPECIES OF Drosophila. Six-months report, due April 30, 1963. TID-18979, Turku, Finland. Univ. 9p.

Preliminary results of genetic studies on D. melanogaster are presented. Analysis of data on 48 males mated singly, sequentially, and daily after the 7th day, or until the male died, for 24 d after treatment with 3000 r x-radiation, indicated that induced crossovers occurred in one brood as pseudoclusters, and that clusters beginning the 12th or 13th day after irradiation and initial mating may continue for a number of broods. (NSA 17:1963, 28599)

- 941 Herskowitz, I.H., Schalet, A., Reuter, M.D.V. INDUCED CHANGES IN FEMALE GERM CELLS OF Drosophila. VIII. EXCHANGES INDUCED IN DIFFERENT X CHROMOSOME REGIONS AFTER X-RAYING OÖCYTES AND OÖGONIA. Genetics 47 (1962) 1663-78.

Following exposure of germ cells of female D. melanogaster either to 3000 to 4000 r or to no dose of x-rays, induced exchanges involving proximal or distal regions of the X chromosome were detected in F₁. The results support the view that x-ray-induced recessive lethal mutants in oöcytes typically arise as the result of events which involve only a single strand of a tetrad.

- 942 Herskowitz, I.H., Norton, I.L. ARRANGEMENT OF CHROMOSOMES IN MATURE SPERM. (1) Drosophila Inform. Serv. 37 (1963) 88-9.

Recessive lethals from 18 MeV electrons are distributed among the sperm of different males according to Poisson expectation, even though some lethals are due to position effects following chromosomal rearrangement. It is pointed out that the usual recessive lethal studies are not likely to furnish readily

critical evidence on the positioning of sperm chromosomes. A study of II-III reciprocal translocations was performed, using 1500 r x-rays. Sperm samples from different single ejaculates were examined. Subject to the correctness of the authors' premise restricting the joining of ends produced by x-ray breakages to those located closely, the results do not indicate that the chromosomes in the different sperm are arranged in an other-than-random fashion.

- 943 Herskowitz, I.H., Lacy, Mother Stanislaus, Baumiller, R.C. ARRANGEMENT OF CHROMOSOMES IN MATURE SPERM. (2) Drosophila Inform. Serv. 37 (1963) 89.

Assuming (1) that proximity of broken ends derived from x-ray tracks of ionization favours cross-union, and (2) that a bias which occurs in orientation of chromosomes at meiosis also results in an orientation bias in the mature sperm, only males were utilized whose sperm chromosomes were all similarly biased in orientation at meiosis, and males whose sperm chromosomes are not biased in such a way. The results indicate, however, that the arrangement of overlapping chromosomes in the sperm head is not appreciably influenced by any orientation which chromosomes may have had during meiosis.

- 944 Herskowitz, I.H. SPONTANEOUS AND RADIATION MUTAGENESIS AND MUTABILITY IN Drosophila. (Abstr. B1F206) p.50 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

The broad purpose of the proposed programme is to learn more about the phenotypic effects of mutations and the factors involved in the production of chromosomal breakage, chromosomal rearrangement, and point mutation occurring spontaneously and induced by radiations in a given cell type, including different stages in its differentiation, and in several cell types. Attempts will be made to construct stocks containing balanced lethals which when mated together result in the death of all progeny during the egg stage, unless non-disjunction or reverse mutation occurs. If such stocks can be constructed, they will be used to study spontaneous and x-ray-induced non-disjunction and reverse mutation of recessive lethals. Various mutational events will be studied, following x-ray or no x-ray treatment of developing eggs, when the adenine available is or is not restricted in the diet of larvae auxotrophic for adenine. Using a diet restricted in adenine, the effects of adding other purines or adenosine to the diet will be studied upon the spontaneous and/or x-ray-induced mutation rate. Several experiments are planned to study the effect of penicillin on x-ray-induced mutations of various kinds.

- 945 Hughes-Schrader, S., Schrader, F. THE KINETOCHORE OF THE HEMIPTERA. Chromosoma 12 (1961) 327-50.

To induce chromosome breakage, adult males and nymphs of Euschistus servus, E. tristigmus, and Solubea pugnax were irradiated with 100 to 750 r doses of x-rays. The diffuse nature of the kinetochore was demonstrated by the ability of chromosome fragments to perpetuate themselves mitotically through many cell generations of spermatogonia. Free fragments, when not immobilized by the effects of radiation, are also capable of meiotic mitosis. A holokinetic, rather than a telomeric, nature was thus demonstrated for the meiotic restriction of kinetochore activity to chromosome ends, normal for Heteroptera and certain other Hemiptera. Simple fragmentation as a factor in the evolution of compound sex chromosomes was supported by the observation that fragments of the X chromosome co-orient with the Y in a typical touch-and-go pairing. (NSA 16: 1962, 10404)

- 946 Ives, P.T., Fink, G.R. COMPARISON OF TRANSLOCATION AND CROSSOVER CHROMOSOMES PRODUCED BY γ -IRRADIATION OF Drosophila MALES. (Abstr. Genetics 47, 8 (1962) 963.

Translocations (Ts) of chromosomes 2 and 3 were derived from days 5 and 6 sperm of Oregon-R/rucua males and crossovers from days 9 and 10 sperm, using an exhaustive mating schedule at 25°C after two hr. Tests showed homozygous lethality in 84 of 102 Ts and in 24 of 105 non-T second chromosomes also derived from days 5 and 6 sperm. The estimated lethality due to a T is 0.35 of a lethal for each of its two chromosomes, with 2.7 T lethals to one non-T lethal per chromosome. In contrast 11 of 141 crossover chromosomes appearing in males and ten of 172 non-crossover sibling third chromosomes from days 9 and 10 sperm were recessive lethals, the difference in these two frequencies being nonsignificant ($P=0.6$). The lower lethality in crossovers versus Ts and the absence of a comparable increase in proportion of lethals in crossover chromosomes support the views that induced crossovers and Ts are genetically different at their exchange sites (Patterson and Stone 1934) and that if both result from induced chromosome breakage then lethality arises not from this breakage but probably from a position effect of genes not themselves affected by the irradiation. (Earlier comparable studies were rendered uncritical by the later discovery of widely divergent induced mutation frequencies at different spermatogenic stages.) A difference between induced male and normal female crossingover is still apparent in their very different proportionate chromosomal distributions.

- 947 Kunze-Muehl, E. UNTERSUCHUNGEN ÜBER DIE VERTEILUNG DER BRUCHSTELLEN NATÜRLICHER UND STRAHLENINDUZIERTER CHROMOSOMENDISLOKATIONEN BEI *Drosophila subobscura* COLL. (Studies on the distribution of breakage sites of natural and radiation-induced chromosome dislocations in *Drosophila subobscura* Coll.) Chromosoma 12 (1961) 286-309. (In German)

Cytologic analysis of radio-induced dislocations was studied in salivary gland chromosomes of the F_1 larvae produced by mating irradiated male flies with normal females. The males, 10-d-old individuals of the Kilsnacht strain, were irradiated with 5000 r. Examination of the salivary glands of 646 F_1 larvae revealed a total of 74 translocations and 30 inversions in 92 larvae. On the basis of previous studies, dislocations corresponded to 234 breakage points. The percentage of dislocations in the sperm ($14.24 \pm 1.37\%$) was lower than that obtained in previous experiments on other *Drosophila* species, at the same radiation dose. The distribution of the 234 radio-induced and 152 natural breakages was considered on a statistical basis, and the results discussed critically. On the basis of small chromosome segments, 3 autosomes were found to show a significant deviation from random distribution.

- 948 Leigh, B. THE INDUCTION OF XO MALES, BY IRRADIATION OF *Drosophila melanogaster* MALES. (Abstr. 5.39) p.68-9 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

It has been found that, after the irradiation of adult males, there is a difference in the sperm samples which show the highest frequencies of lethals and translocations, and those which show the highest frequency of XO males. A set of experiments were carried out to investigate this discrepancy. Twenty-four-hour old males, of the genetic constitution $X^{O2}Y; sc^8 Y$, were treated with doses from 0-3000 r. A brood pattern of five 2-d broods was used, with 6 females per male per brood. The F_1 was scored for XO males, non-disjunction females, and sex ratio. The highest frequency of XO males was found in sperm sampled on the 7-8th days after irradiation, presumably corresponding to young spermatocytes, and this was not accompanied by any comparable increase in the number of non-disjunction females. From the structure of the ring-X it is expected that most breaks will result in loss of the chromosome. This is supported by the fact that the same dose of irradiation produces more XO males from the ring-X than from a rod-X. The dose effect curve for the production of XO males is a straight line, one-hit event. A comparison of this dose effect curve with that of the change in sex ratio gives further evidence that XO males are mainly produced by loss of the X chromosome. A hypothesis to explain the different peaks for the 2 types of breakage-involving effects, XO males and translocations, is discussed.

- 949 Lindsley, D.L. GENERAL SURVEY OF GENETIC EFFECTS OF CHROMOSOMAL ABERRATIONS. p.273-89 in "Report of a Conference on Radiation-Induced Chromosome Aberrations held in San Juan, Puerto Rico, 16-18 November 1961". Wolff, S. Ed New York, Columbia University Press. 1963.

Genetic effects of radiation on mature *Drosophila* sperm are discussed. It is concluded that single breaks that occur too far from another break to interact with it, if they occur, do not remain open, do not form dominant lethals, and thus by a process of elimination must reconstitute. When there are two broken strands within a site, three types of intrachromosomal rearrangement are possible: (1) they may reunite to form a chromosome unchanged except for mutational scars, (2) they can rejoin to produce an acentric ring and a rod deficient for the region included in the ring, or (3) they may rejoin to form an inversion. Interchromosomal rearrangements and the situation where, within a site, there are two different arms are also considered. Two such breaks may reconstitute, they may rejoin to produce a dicentric and an acentric, or they may form reciprocal translocations. Translocations between the X chromosome and the autosomes are used to illustrate how the genetic effects of aberrations may affect the validity of scoring procedures. (NSA 17:1963, 25016)

- 950 Linnig, K.G. CAN *Drosophila* SPERMATOZOA BE USED IN STUDIES OF RECOVERY PROCESSES? J. cell. comp. Physiol. Suppl. 1 58 (1961) 197-201. Symposium on "Recovery of Cells from Injury" Gatlinburg, Tennessee, 3-6 April 1961.

Data are presented on the x-irradiation of sperm in pure O_2 , air, or in nitrogen mustard, followed by mating within the first 24 h. Data on the effects of dose fractionation on the induction of point mutations and chromosome breaks are also included. The results cannot be interpreted as proving the occurrence of a recovery process in sperm irradiated in a stage supposedly rather well supplied with oxygen. The need for dealing with well-defined cell stages is heavily stressed by the author, in view of the otherwise inevitable heterogeneity in results.

- 951 McCarthy, J.C., Nafai, H. A TEST FOR X-RAY INDUCED TRANSLOCATIONS IN SPERMATOGONIA OF Drosophila melanogaster. Genet. Res. 4 (1963) 486-6.
- The frequency of genetically detectable translocations was determined in spermatozoa, spermatocytes, and early and late spermatogonia in irradiated male D. melanogaster. The males were exposed to 3000 r of x-radiation and mated to 3 types of tester females. Results are presented in tabular form. (NSA 18: 1964, 8156)
- 952* Mainx, F. STRAHLENINDUZIERT UND NATÜRLICHE CHROMOSOMENDISLOKATIONEN BEI Drosophila subobscura. (Radiation-induced and natural chromosome dislocations in Drosophila subobscura.) p.567-73 in "5a Rassegna Internazionale Elettronica e Nucleare. Atti del Congresso Scientifico. Sezione Nucleare. 16-20 Giugno 1958. Vol.1". Rome, Palazzo dei Congressi - E.U.R. (In German)
- A preliminary report on investigations of radiation-induced and natural chromosome dislocations in Drosophila subobscura is presented. A localization of 152 breaks of the natural inversions shows that the distribution of the broken places over the chromosomes does not follow a probability distribution. The inversions and translocations caused by x-radiation show the same distribution.
- 953 Mainx, F., Doschek, E. CROSSING-OVER IN IRRADIATED FEMALES AND MALES OF Megaselia (PHORIDAE). (Abstr.7.29) p.127 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.1". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.
- Megaselia scalaris has become an interesting object for genetic studies in many respects. A new type of sex determination was discovered in this fly and reported on recently. Crossing-over occurs also in males. The crossing-over values are considerably reduced in males. The differing rates of this reduction depend on the localization of a given zone in the chromosome. Crossing-over values increase after irradiation of the pupae to a certain extent. This increase again differs for particular chromosomal zones in female and in male. Established on these results a new theory of crossing-over could be considered.
- 954 Manna, G.K., Mazumder, S. THE GRASSHOPPER X-CHROMOSOME AS AN INDICATOR FOR X-RAY INDUCED CHROMOSOME BREAKAGE. Proc. Calcutta Zool. Soc. 16, 2 (1962) 103-10.
- X-ray induced X-chromosome breakage at the diplotene stage in the grasshopper, Gesonula punctifrons has been studied. The breakages of the X-chromosomes have been classified as "chromatid", "chromosome" and "mixed" type breakages and their frequency distributions have been recorded at 80 r 160 r, and at 240 r of x-rays. The frequency of breaks is directly proportional to the dosage used. The radiation breaks of the X-chromosomes are not at random, and regional localizations of the breaks have been observed not only in G. punctifrons but also in 2 other species of different genera. A difference in the frequency of breakages at a given dose among the different species has also been observed. Our data show that the frequency of radiation induced X-chromosome breakages is much higher than that of the autosomes. (Auth.)
- 955* Nakanishi, Y.H. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION AND CHEMICALS ON THE CELL AND THE CHROMOSOMES. I. TYPES OF X-RAY-INDUCED CHROMOSOME ABNORMALITIES IN GRASSHOPPER SPERMATOCYTES, WITH A NOTE ON THE NORMAL COURSE OF THE FIRST DIVISION AS CONTROL. J. Fac. Sci. Hokkaido Univ., Ser. VI. Zool. 14 (1958) 83-91.
- 956* Nakanishi, Y.H., Makino, S. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION AND CHEMICALS ON THE CELL AND THE CHROMOSOMES. II. FORMATION OF ANUCLEAR BUDS, CONTINUATION OF CHROMOSOME STICKINESS AND FORMATION OF AN ACCESSORY NUCLEUS IN GRASSHOPPER SPERMATOCYTES FOLLOWING X-IRRADIATION. Tex. Rep. Biol. Med. 18 (1960) 66-74.
- 957 Nelson, D.J., Blaylock, B.G. THE PRELIMINARY INVESTIGATION OF SALIVARY GLAND CHROMOSOMES OF Chironomus tentans FABR. FROM THE CLINCH RIVER. p.367-72 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.
- Some of the Chironomus tentans Fabr. larvae collected from White Oak Creek and the Clinch River have unusual forked preanal gills. A subsequent cytogenetic study showed the salivary gland chromosomes of the C. tentans population contain what appears to be a relatively high frequency of chromosomal aberrations. 23 individuals in a sample of about 300 were found which had 3 chromosomes each instead of the usual 4. These populations from areas contaminated with radioactive waste effluents have not been compared with

other local populations not exposed to these effluents. The radiation from radionuclides sorbed on the river and creek bottom sediments is 20 to 1000 times that of natural background. The larvae are also exposed to a heterogeneous mixture of chemicals in the effluent released to the environment. The mutagenic effect of chemicals is erratic when compared with the effect of ionizing radiation. (Auth. summary).

- 958 Nelson-Rees, W.A. THE EFFECTS OF RADIATION DAMAGED HETEROCHROMATIC CHROMOSOMES ON MALE FERTILITY IN THE MEALY BUG, Planococcus citri (Rossi). Genetics 47, 8 (1962) 661-83.
The chromosomes contributed by the father to the zygote of male mealy bugs become heterochromatic at late blastula. This complement does not itself form gametes. However, the present results indicate a decided influence of this set on fertility of the male and can no longer be considered genetically inert. Following high dosage γ -irradiation of fathers, a certain bulk of heterochromatin (based on linear measurements of the holokinetic entities), no matter how deranged, must be present for the survival of the sons, and a presumably less affected set must be present for the sons to be fertile to any extent. With increase in dosage there is a quantitative reduction of fertility of the sons based on the production of fewer normal functioning sperms. This is due to a gradual onset of derangements in spermiogenesis at all doses, but an increased total effect with increase in dosage. (Auth.)
- 959 Novitski, E. CHROMOSOME BREAKAGE IN INVERSION HETEROZYGOTES. Amer. Nat. 95, 883 (1961) 250-1.
Note follows up some opinions expressed by the author and taken up by Bernstein and Goldschmidt (*ibid* 53). After some comments, Novitski describes an experiment in which Drosophila melanogaster females, heterozygous for the inversion roughest (Genetics 31:1946, 508), were x-rayed with 1800 r. Male progeny were examined for loss of the position effect. Of some 32 000 progeny checked, 6 cases of reversion were found which appeared, after extensive investigation, to be precise reinversions, genetically indistinguishable from a normal chromosome.
- 960 Novitski, E. THE REGULAR REINVERSION OF THE ROUGHEST⁺ INVERSION. Genetics 46 (1961) 711-7.
Females heterozygous for the roughest inversion were x-rayed, and their progeny examined for reversions of the phenotype. Six were found which, by both genetic tests and cytological examination, appeared to be precise reinversions of the roughest⁺ inversion. It is suggested that the inversion loop formed in the heterozygote facilitates breakage and reunion in the vicinity of the break points of the original inversion. (Auth. summary)
- 961 Novitski, E., Hanks, G.D. ANALYSIS OF IRRADIATED Drosophila POPULATIONS FOR MEIOTIC DRIVE. Nature, Lond. 190 (1961) 989-90.
Irradiated populations of Drosophila were analysed for the existence of chromosomes or alleles represented in the gametes of a heterozygote with a frequency greater than the expected 50%. Such phenomena have been referred to as cases of meiotic drive when the bias is found in some aberration of meiosis. Chromosomes were tested that had received light doses of radiation each generation for about 200 generations. The genetic tests consisted of back-crossing heterozygotes for chromosomes derived from the irradiated populations and for stock chromosomes carrying mutant genes to the mutant stock in order to detect any deviation in the progeny from the expected 50% of each type. Of 1654 tests there were 2 instances in which the chromosomes derived from the irradiated population were recovered in significantly more than 1/2 the progeny, and where this deviation persisted after repeated testing. (NSA 15:1961, 23317)
- 962 Olivieri, A., Olivieri, G. DOSE-EFFECT RELATION IN THE INDUCTION OF CROSSING-OVER WITH X-RAYS IN MALES OF Drosophila melanogaster. Atti Accad. Naz. Lincei Memorie Classe di scienze fisiche e matematiche 34 (1963) 685-95. (In Italian)
Males, 0-24 h old, heterozygote in the 2nd chromosome for b cn vg bw, were exposed to x-ray doses of 500, 1000, 2500, and 4000 r. They were bred with b cn vg bw females, and the cross-overs found in the descendants of the 7th to the 21st day after irradiation were determined. Results are tabulated and their significance discussed in detail.
- 963 Olivieri, A., Olivieri, G. INDUCTION OF CROSSING-OVER IN Drosophila melanogaster MALES WITH VARIOUS DOSES AND FRACTIONATED DOSES OF X-RAYS. Atti Ass. genet. ital. 8 (1963) 181-93. (In Italian).

Studies on the induction of crossing-over in male D. melanogaster chromosomes following exposure to various dose rates and fractionated doses of x-rays showed the existence of a stage of greatest sensitivity during spermatogenesis. A significant decrease of induced crossing-over in the centromeric region was observed after exposure to fractionated doses. The possible relation between radio-induced crossing-over and chromosome breaks is discussed. (NSA 17:1963, 28709)

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Olivieri, G., Olivieri, A. INDUCED CROSSING-OVER IN MALES OF D. melanogaster. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 382-3.

Two main hypotheses have been put forward to explain the appearance of "clusters" of crossovers in some male offspring, following radiation. Cluster induction was measured in males irradiated with different and fractionated doses in order to obtain some indications of cluster origin. If clusters are produced by a single gonial crossing-over cluster size should not be affected, which it would be if produced by many crossings-over induced in equally sensitive cells. If the time during which the cells are sensitive is shorter than the interval between different treatments, the single dose-effects should not sum up. A pilot experiment was therefore performed in which males heterozygous for cn vg, 0-24 h old, were irradiated with 500 r, 4000 r and 4000 r delivered in 10 h by 500 r doses (180 kV, 6 mA, 3 mm Al, 300 r/min). The males were mated with 2 females each, on 1, 3, 6, 9, 12, 15, 18, 24, 30 and 36 day after irradiation. In the following experimental results "cluster" is defined as a group of events - occurring in a single individual - lying outside a Poisson distribution. These events are the induced crossings-over that can be referred to the same male according to the number and type of crossovers found in its offspring after restoration of fertility (in our case after the 12th day from irradiation). In the sample of 81 males irradiated with 500 r there were no clusters in the offspring of 17 males, which produced crossovers whose frequency-distribution was of the Poisson type; in the sample of 93 males irradiated with 4000 r, clusters appeared in some of the 48 males which produced crossovers. Even with fractionated treatments clusters have been obtained, but in this case the distribution is more in agreement with the Poissonian type. Moreover, in these two last treatments, the number of males producing crossovers was lower than expected. It thus appears that during spermatogenesis cells show a "sensitive stage" for induced crossing-over. In consequence of the synchronism of maturation, there could be at the same moment several cells in that stage; but, on the other hand, it may be that none of these cells is present in some males at the moment of irradiation. This could show up by giving a high dose of radiation, even in fractionated treatments, if the "sensitive stage" is longer than the interval between the different fractions. A low dose, on the contrary, should not induce a sufficient number of breakages in sensitive cells to produce enough crossings-over to form a cluster. (From abstr.)

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Oster, I.I., Balaban, G. CYTOLOGICAL DEMONSTRATIONS OF INDUCED BREAKAGE IN SOMATIC CHROMOSOMES OF Drosophila. (Abstr.) Genetics 47, 8 (1962) 974-5.

X-rayed and chemical mutagen-treated larvae of Drosophila have been shown to exhibit an increase in preimaginal mortality and a decrease in the life-span of the surviving adults. This phenomenon, essentially akin to the premature ageing observed in irradiated mammals, has been shown by several genetic tests to be based on chromosomal loss (Oster 1959; Muller and Oster 1959). One of these involved the use of males containing a ring-shaped X-chromosome. Since ring chromosomes are more prone to loss following breakage than normally-constituted chromosomes, males hemizygous for the former are more susceptible to mutagen-induced life-shortening. - Direct cytological observation of this damage would offer additional confirmation for our interpretation based on the breeding results and a simple method for testing other agents as possible mutagens. - By utilizing a combination of techniques recently introduced by E.B. Lewis (Drosophila Inform. Serv., 34) for demonstrating the mitotic chromosomes of Drosophila larval ganglia and a lactic-acetic orcein-fast green stain developed by Rudkin and Kammer (unpublished) we have been able to obtain preparations with 15-20 figures per ganglion in which the full complement of chromosomes can be clearly analysed (Oster and Balaban, Drosophila Inform. Serv., 37). - Preliminary observations have yielded results completely in agreement with the genetic tests, i.e., the relatively high susceptibility to loss following irradiation of ring-shaped chromosomes as evidenced by their breakage and frequent involvement in anaphase bridges. Such effects can also be observed following exposure to relatively low doses of x-rays. - Also this method has been successfully applied to the somatic chromosomes of the housefly.

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Oster, I.I., Pooley, E., Schwarz, R. SPONTANEOUS AND INDUCED NON-DISJUNCTION IN Drosophila melanogaster. Genetica 28p. (quoted as "in press" in 1963).

- 967 Oster, I.L., Pooley, E. THE EFFECT OF ACCESSORY CONDITIONS ON X-RAY INDUCED NON-DISJUNCTION IN Drosophila. Genetica 10p. (quoted as "in press" in 1963).
- 968 Osterag, W. THE GENETIC BASIS OF SOMATIC DAMAGE PRODUCED BY RADIATION IN THIRD INSTAR LARVAE OF Drosophila melanogaster. Diss. Abstr. 22, 5 (1981) 1356-6.
- Somatic damage to larvae can be attributed to loss of chromosomes via the breakage-fusion-bridge-loss process. Females have a higher radioresistance than males through all dosage ranges tested, the differential sensitivity being expressed throughout the subsequent life of the flies until death of the whole irradiated generation. (Note higher radiosensitivity with heterozygous deficiency in one of the second chromosomes. The radiosensitivity of the autosomes is roughly twice that of the X chromosomes. The presence of a ring-X in females heterozygous for it and for a deleted rod, or in males, leads to a higher radiosensitivity than in flies having a normal rod-X in place of the ring. The effect of post-treatment with N_2 increases the differential sensitivity to a level 33% higher than in the irradiated but non-treated larvae. A simple model is developed explaining the action of radiation in producing somatic damage all through the life of the fly (unpublished mathematical model). The present results leave no major role for the cytoplasm or other non-chromosomal components in the causation of somatic radiation damage in Drosophila larvae. Genetic effects other than breakage by radiation could at most play a minor role in the effects described.
- 969 Puro, J.A. THE BROOD PATTERN OF X-RAY INDUCED CROSSING-OVERS IN Drosophila melanogaster MALES. (Abstr. 5.40) p.69 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.1". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.
- The pattern of induced crossing-overs in D. melanogaster males was studied using a hybrid stock of 12 recessive markers in the third-chromosome. Adult males, after treatment with 3000 r x-rays, were mated singly and sequentially (at 2- or 3- d intervals for the first three broods and daily from the 7th to the 24th d) to females of an appropriate genotype for detecting crossovers. Fertility and fecundity of the treated males, after decreasing to the lowest level on d 8, had a marked recovery on day 10 followed by a small depression on days 11 and 12; no differences between the experimental and controls were found for any of the rest of the broods. The number of tested F_1 offspring totalled 51 964 from 46 treated and 25 778 from 11 control males. With rare exceptions, proven crossovers were first detected on the 9th d but the highest incidence was on the 10th d after treatment. Clusters of crossovers, many of which continued in several broods, began on the 11th or 12th d. The evidence from the continuing crossover-clusters substantiates the hypothesis proposed by the author (1962) from clusters of recessive third-chromosome lethals, that the treated predefinitive gonads - on an average 5 in number per male, basing the estimation upon the size of clusters - are responsible for the recovery of sperm production to the control level by the 12th d. Furthermore it appears that the high incidence of crossovers, on the 10th d, is the result of induction of crossovers in definitive (secondary) gonads.
- 970 Ray-Chaudhuri, S.P. INDUCTION OF CHROMOSOME ABERRATIONS IN THE SPERMATOCYTES OF GRASSHOPPERS. Nucleus 4, 1 (1961) 47-66.
- X-ray-induced abnormalities in metaphase and anaphase cells are described for meiotic cells of male grasshoppers (Gesonula punctifrons). Independence from dose-rate but a dependence on the wavelength was observed. Different irradiating temperatures (4°C and 37°C) had no effect. An attempt was made to compare aberrations produced by x-rays with those from absorbed P^{32} . A series of experiments are mentioned in which dicentric bridges are used as an index of radiation damage to chromosomes (pre-treatment with sodium azide, versene (ethylenediaminetetraacetic acid), and cysteamine)).
- 971 Rasmussen, M. UNEQUAL CROSSING-OVER IN THE BAR REGION OF Drosophila melanogaster. INFLUENCE OF TEMPERATURE, X-RAYS AND EDTA. Hereditas 47, 2 (1961) 357-78.
- Unequal crossing-over in the Bar segment of D. melanogaster, giving rise to reverted B^+ and BB , were used in a study of induced crossing-over to reveal the possible presence of clusters. High temperature (31°C for 48 h), x-rays (4000 r and 2500 r), and EDTA (a chelating agent known to deprive the organisms of calcium) were used as enhancing treatments. Frequency of crossing-over in the region f-car was registered and compared to the frequency of unequal crossing-over in the Bar segment. High temperature and the higher x-ray dose were found to be effective in raising the frequency of crossover. The lower x-ray dose was without effect and the EDTA treatment was dubious but seemed to enhance the frequency to a small extent in the later broods. Since a significant increase in crossing-over frequency has been observed without the simultaneous presence of clusters, it is inferred that induction of gonial crossing-over with subsequent multiplication of the crossover products is not the cause of the enhancing effect of the treatments. The

enhancing effect can be supposed to work directly on the recombination process during pre-meiotic interphase or earliest leptotene, 5-10 d before the delivery of the eggs. This probably holds both for high temperature and the effective x-ray dose. Whether the EDTA effect is exerted in the same manner and at the same time cannot be decided until the treatment becomes more exactly time-limited and quantitative.

- 972 Sävhaugen, R. THE RELATIONSHIP BETWEEN TYPE OF ABERRATION AND SENSITIVITY PATTERN IN IRRADIATED *Drosophila melanogaster* MALES. *Hereditas* 47 (1961) 190-6.

Differences between sensitivity patterns for various types of induced genetic damages were compared and found to reflect the relationship between the different mechanisms at work in producing damages and the cell stage treated. It was concluded that there exists not only a marked difference in sensitivity to irradiation between various stages of spermatogenesis in *Drosophila*, but also a difference in sensitivity according to which type of aberration is studied. It is also obvious that the changes in sensitivity are delimited to very short intervals during spermatogenesis. (NSA 16:1962, 17468)

- 973* Sengün, A. EFFECTS OF X-RAYS ON SALIVARY-GLAND CHROMOSOMES DURING EARLY STAGES OF DEVELOPMENT. *Nucleus* 1 (1958) 162-72.

Embryos of *Drosophila melanogaster* (4-6, 10-12, and 16-18 h old), larvae (22-24, 58-60 h old) and older 3rd-instar larvae were irradiated with ~3500 r x-rays. Chromosomes from the salivary gland, mid-gut, and Malpighiantubule cells were examined in aceto-orcein or in aceto-carmin smear preparations made from old 3rd-instar larvae and pre-pupae. In salivary-gland chromosome preparations from larvae irradiated at the age of 4-6, 10-12, 16-18, and 22-24 h some structural abnormalities ("partial rearrangements" of Slizynski) were observed. They could be regarded as partial inversions, translocations and deficiencies. The nature of these rearrangements is discussed.

- 974 Slizynska, H. ORIGIN OF REPEATS IN *Drosophila* CHROMOSOMES. *Genet. Res.* 4 (1963) 164-7.

Rp, a type of duplication where a segment of one chromatid is inserted next to its homologous segment in the sister chromatid, are induced by x-rays at a very low frequency and some chemical mutagens are capable of inducing Rp's with a high frequency. Attempts were made to deduce the mechanism responsible for the origin of Rp's from a cytological study of different types of Rp and their relative frequencies, based on x-ray and formaldehyde-induced Rp's in *D. melanogaster*. Four types of Rp were found during cytological analysis of the effects of formaldehyde food, and all can be explained by a mechanism which requires two breaks in a still undivided chromosome; after splitting of the chromosome, these breaks result in two pairs of isochromatid breaks. Depending on the type and the number of new rejoinings, different types of Rp are formed. All of them are accompanied by the same complementary deficiencies (Df). In order to result in a Rp with complementary Df, the breaks have to fulfil special conditions. A proposed model for the origin of repeats suggests that these may arise most readily from chromosome breaks which remain latent (potential) until separation into sister chromatids. This is in excellent agreement with the fact that formaldehyde, which produces mainly potential breaks, yields a high frequency of Rp's, while x-rays yield very few. (From NSA 18:1964, 11728)

- 975 Sokoloff, A. STUDIES ON FACTORS AFFECTING CROSSING OVER IN *Tribolium castaneum*. *Tribolium Inform. Bull.* 6 (1963) 57-60.

In one series of experiments 14 males and 8 females (genetically *Be s/+*) were exposed to 3210 r of x-rays (1070 r/min through a 1 mm Al filter). The irradiated beetles were mated to a number of *s/s* beetles corresponding to the number in the controls, and their progeny reared in the same incubator as the controls. Irradiation results in a marked drop in productivity, especially in females. The frequency of crossing over for irradiated females is comparable to that obtained for the controls. On the other hand, Chi square tests for homogeneity for other tests suggest that the increase in crossing over in the males as a result of irradiation is real. With irradiation, crossing over is increased in frequency in the male but not affected in the female. It is modified by age, but probably only in the male.

- 976 Strangio, V.A. RADIOSENSITIVITY TO CERTAIN BREAKAGE ABERRATIONS DURING SPERMATOGENESIS IN *Drosophila melanogaster*. *Drosophila Inf. Serv.* 35 (1961) 96-8.

- 977 Tikhomirova, M.M. AFTER-EFFECT OF ROENTGEN RAYS UPON PRIMARY NON-DISJUNCTION OF X-CHROMOSOMES. p. 198-202 in "Pervichnye Mekhanizmy Biologicheskogo Del'stviya Ioniziruyushchikh Izlucheniĭ". Moscow, Publishing House of the Academy of Sciences, 1983. (In Russian).
- The question of whether the radiation effect is confined only to the recorded genetic effect observed under ordinary conditions or whether there arise in the cells potential changes revealed only upon additional treatment is discussed. The frequency of primary non-disjunction of X-chromosomes was followed up for Drosophila irradiated with 3000 r and subsequently exposed to +37 °C during 8 h after various time intervals. It is concluded that the phenomenon of radiation after-effect upon the disjunction of chromosomes does exist. (Auth.)
- 978* Traut, H. ON THE IDENTIFICATION OF RADIATION INDUCED DELETIONS OF THE X-CHROMOSOMES OF D. melanogaster. Drosophila Inform. Serv. 34 (1960) 108.
- 979 Traut, H. THE LINEAR DOSE-DEPENDENCE OF RADIATION-INDUCED TRANSLOCATION FREQUENCY IN Drosophila melanogaster AT RELATIVELY LOW X-RADIATION DOSES. Int. J. Rad. Biol. 7, 4 (1963) 401-3.
- Sperm stored in females, which can be considered the most homogeneous germ-cell stage available in Drosophila, were irradiated with 150 kV x-rays, at 500 r/min. The statistical test based on weighted regression analysis shows no indication for departure from linearity for the dose-range from 0-0.5 kr ($P=0.70$), while there is a high degree of significance for the linear term ($P=10^{-40}$). The experimental points can be fitted by the equation $y=0.071+1.16x$ (y =translocation frequency in percentage, x =exposure in kr). Results of work using γ - and neutron radiation are considered; it appears that in the low dose-range, neutrons are much more efficient in the production of two-break chromosome aberrations than x- and γ -rays.
- 980 Uchida, I.A. THE EFFECT OF MATERNAL AGE AND RADIATION ON THE RATE OF NON-DISJUNCTION IN Drosophila melanogaster. Canad. J. Genet. Cytol. 4, 4 (1962) 402-8.
- Virgin females were aged from 1-29 d before exposure to 1850 r of γ radiation. Yellow body (y) was used as the non-disjunction marker on the X chromosome. There was a 7-fold increase in the frequency of exceptional flies among the progeny of irradiated females compared with the controls. There is no evidence of an increased rate of non-disjunction with aging in the absence of radiation. In the irradiated series there is a positive correlation between the rate of non-disjunction and maternal age. (Auth.)
- 980-a Wallace, B. ON RELATIVE VIABILITY AND REPLACEMENT. Proc. nat. Acad. Sci., Wash. 50 (1963) 514-24.
- A type of replacement exists that could seriously alter the outcome of studies on the viability of irradiated X chromosomes. Conditions under which the replacement could occur were defined, and a search was made for this kind of replacement by comparing the number of Drosophila melanogaster of various genotypes emerging in comparable lethal and nonlethal cultures. Approximately 5000 control and irradiated X-chromosomes were tested. Levels of radiation used were 500, 1000, and 2000 r of x-rays. A total of 77 lethals were recovered among irradiated cultures, for which 77 non-lethals were chosen for comparative analysis. It was found that heterozygous females carrying an irradiated chromosome do not possess a unique replacement ability. Lethal heterozygotes have somewhat impaired viabilities, but there is no evidence in this data that replacement of the sort that causes spurious ratios occurs in the tests involving the X-chromosome. Evaluations are made of suggestions on experimental data interpretations. (NSA 17:1963, 40601)
- 981 Warters, M. X-AUTOSOMAL TRANSLOCATIONS OF Drosophila melanogaster. (Abstr. B1A341) p.31 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.
- Translocation studies on Drosophila melanogaster have shown that a high degree of sterility can be expected in the male if the X-chromosome is involved in the translocation. The investigation underway was designed to determine the amount of sterility to be expected and, if possible, the factors responsible. A special procedure had to be designed which would permit the recovery of the induced translocations through the F_2 females of irradiated parents rather than through the F_1 males which is the standard method. The new technique proved very effective in recovering both male sterile and male lethal classes of X-autosomal translocations which otherwise would have been lost through the haploid male. A sample of

180 X-autosomal translocations has been obtained of which 78 are $T(X; 2) \frac{1}{2}$, 68 $T(X; 3) \frac{1}{2}$ and 36 $T(X; 2; 3) \frac{1}{2}$. Of the first two classes approximately 19% of the males fail to survive and 75% of the viable males are sterile. Cytological studies are now under way to determine whether a correlation can be found between the break-points on the chromosomes and sterility. Evidence from some studies would lead to the hypothesis that any interruption in the continuity of the X-chromosome would lead to sterility. This has not been confirmed by the analysis of half of the sample of translocations.

- 982 Whittinghill, M., Davis, D.G. INCREASED RECOMBINATION FROM FEMALE Drosophila IRRADIATED AS LARVAE WITHOUT OOCYTES. Genetics, 46 (1961) 357-60.

Different x-ray doses to late 3rd instar larvae of Drosophila produced elevated frequencies of crossovers only from eggs laid in the 1st week of the imagoes. 3 broods from 8- to 21-d-old adults were homogeneous among control and 3 irradiation dosage groups. Comparison of non-crossover and crossover frequencies showed no evidence of radioresistant cells among the oögonia present in x-rayed larvae. Higher crossover and lower non-crossover values were found in the 14- to 21-d brood rather than in the earliest brood of the controls. This response of Drosophila and the lack of such response of Habrobracon to irradiation are discussed. (Auth.)

- 983 Whittinghill, M., Allen, A.C. UNCHANGED RECOVERY OF CROSSOVERS AFTER X-IRRADIATION OF PUPAL Habrobracon. Genetics 46, 5 (1961) 581-4.

To find whether recombination could be increased in H. juglandis by heavier irradiation than is necessary in Drosophila and to concentrate on gonial cells as "targets", white pupae were given 1000 r, 2500 r, or 4000 r, and the resulting adult females were placed as virgins with fresh hosts every 2nd day for 9 transfers or more. Fertility of control, 1000 r, and 2500 r categories was high, and it was reduced only in the 4000 r females. Crossover values in the black-lemon-cantaloup-honey regions showed no significant change with treatment, or with age or between individual families. The lack of radioresponse and the lack of age changes are perhaps caused by the lack of somatic pairing of chromosomes in the Hymenoptera. (Auth.)

- 984* Wolff, S. CHROMOSOME BREAKAGE AND REJOINING IN IRRADIATED SPERM OF Drosophila. (Abstr.) Genetics 44, 4 (1959) 545.

- 985 Wolff, S. CHROMOSOME SPLITTING AS REVEALED BY COMBINED X-RAY AND LABELING EXPERIMENTS. (Abstr. BIA1001) p.60 in "Research and Development in Progress. Biology and Medicine. Issue No. 2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Cells were either labelled by a short treatment with H^3 -thymidine and then x-rayed, or x-rayed and subsequently labelled. Cells were sampled as they reached metaphase at successively later times and scored for the type (chromosome or chromatid) of aberration present and whether labelled. The fact that the chromosome reacts as though double in the very early part of DNA synthesis even though the majority of the DNA is not added to the chromosome until later suggests that the protein moiety rather than the nucleic acid contributes to the linear continuity. Experiments in which attempts had been made to label the chromosomal protein during duplication were unsuccessful because labelled amino acids are incorporated into nuclear proteins throughout interphase, making it impossible to distinguish those cells in which the protein was doubled.

- 986 Wolff, S. THEORETICAL KINETICS FOR TWO-HIT CHROMOSOME EXCHANGES. (Abstr. BIA1002) p.60-1 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Expressions for the yield of two-hit exchanges have been derived. The theoretically expected values from these give very good fits to existing Tradescantia, Drosophila, and human chromosome data without necessitating the interposition of extraneous factors to account for the shape of the curves.

- 987 Zimmering, S. GENETIC EVIDENCE OF X-RAY-INDUCED EXCHANGES OCCURRING AT A FOUR-STRAND STAGE IN Drosophila SPERMATOCYTES. J. Hered. 53 (1962) 254-6.

Evidence is presented that x-ray-induced exchanges between X and Y chromosomes occur at a 4-strand stage in spermatocytes D. melanogaster. The evidence consists of the recovery of certain exceptional female progeny that received both of their X chromosomes from the irradiated male parent, one of these being a crossover and the other a non-crossover chromosome.

988 Zimmering, X., Wu, C.K. RADIATION INDUCED X-Y EXCHANGE AND NONDISJUNCTION IN SPERMATOCYTES OF THE IMMATURE TESTIS OF Drosophila. Genetics 48 (1963) 1619-23.

The x-irradiation response of primary spermatocytes of the immature testis of D. melanogaster was investigated employing a genetic scheme which made possible an immediately classifiable distinction in the offspring between nondisjunction of X and Y, and exchange between X and Y in the treated male. (NSA 18:1963, 5047)

See also:

- 103 Terrestrial and fresh-water ecology - radiation effects on Chironomus tentans. (Auerbach, 1963)
- 121 Radiation effects on biota. (Morton, 1961)
- 122 Radiation effects on biota - estimated radiation dose received by Diptera with life stages in bottom sediments. (Morton, 1962)
- 179 Radioisotopes and the genetic mechanism: cytology and genetics of divalent metals in nuclei and chromosomes. (Steffensen and LaChance, 1960)
- 479 Cytogenetic studies of x-ray and ingested P^{32} induced sex-linked recessive lethals in Drosophila melanogaster. (Walen, 1962)
- 753 Ionizing radiations and the induction of chromosome mutations in the germ cells. (Ray-Chaudhuri, 1961)
- 760 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1961)
- 770 The induction of mutations in spermatocytes of Drosophila melanogaster with x-rays. (Chandley, 1962).
- 771 Developmental-genetic study of the effect of x-ray irradiation in Drosophila virilis and Bufo varilliceps. (Clayton, 1961)
- 787 Genetic and direct effects of gamma radiation on Drosophila. (Ives, 1963)
- 824 The role of recovery mechanism and oxygen effects upon changes in radiation sensitivity in sperm treated in mature males and fertilized females of Drosophila. (Alexander, 1962)
- 838 X-ray induced sex-linked recessive lethals and visibles in Sciara (i.e. Bradysia) coprophila. (Crouse, 1961)
- 851 Structure of "yellow" mutations induced by x-rays of scute³ chromosomes of different germ cells in Drosophila melanogaster. (Frye, 1961).
- 883 Cytological effects of x-rays in relation to dose-rate in Drosophila melanogaster. (Gunson, 1962)
- 882 The correlation between radiation-induced male sterility and reciprocal translocation in Drosophila. (Lindsley et al., 1962)
- 901 Radiation and mutation rate. (Stem, 1963)
- 913 Studies of mutation and of recombination in the same chromosomes of irradiated female Drosophila melanogaster. (Whittinghill, 1963)
- 989 The immediate cytological effects of ionizing radiations. (Carlson, 1958)
- 1000 Mutagenic sensitivity of sperm, spermatids, spermatocytes, and spermatogonia in Drosophila melanogaster. (Chandley and Bateman, 1961)
- 1002 Effects of x-ray irradiation in Drosophila virilis at different stages of spermatogenesis. (Clayton, 1962)
- 1013 A cytogenetic study of the effects of x-irradiation on Aedes aegypti. (Rai, 1963)
- 1017 The relation between the rate of induced translocations and treated cell stages in males of Drosophila melanogaster. (Sävthagen, 1960)
- 1018 The relation between x-ray sensitivity and stages of development of treated cells in spermatogenesis of Drosophila melanogaster. (Sävthagen, 1961)
- 1019 Cell stages and differential sensitivity to irradiation in males of Drosophila melanogaster. (Sävthagen, 1963)
- 1023 Radiosensitivity during spermatogenesis in Drosophila melanogaster. (Strangio, 1962)
- 1026 The effect of asynapsis on mutability in the testis of Drosophila. (Thompson, 1961)
- 1027 Asynapsis and mutability in Drosophila melanogaster. (Thompson, 1962)
- 1028 Synaptic modification of dominant lethal frequencies after irradiation of the Drosophila testis. (Thompson, 1962)
- 1038 Biological damage in the mature sperm of Drosophila virilis in oxygen and nitrogen with different dose intensities of gamma rays. (Alexander and Bergendahl, 1962)
- 1042 Radiation sensitivity in sperm treated in males and inseminated females of Drosophila with x-rays in nitrogen and air. (Alexander and Bergendahl, 1962)

- 1058 Nitrogen-treatment effects on rearrangement-induction patterns in Drosophila melanogaster. (Falk, 1961/2)
- 1083 AET and MEA as protection against radiation induced chromosomal aberrations in Drosophila. (Mittler, 1963)
- 1087 Differential yields of mutations from the first and second matings after irradiation of mature sperm in Drosophila melanogaster. (Mossige, 1963)
- 1089 Phase cinematography studies on the effects of radiation on the cell, with special regard to the behaviour of the chromosomes in grasshopper spermatocytes in response to x- and beta-irradiations. (Nakanishi et al., 1961)
- 1098 The mutational spectrum with special reference to the induction of mosaics. (Oster, I.I.)
- 1099 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)
- 1100 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)
- 1113 Protective action of Versene against radiation damage to grasshopper chromosomes. (Ray-Chaudhuri and Saha, 1960)
- 1114 Cysteamine protection of grasshopper chromosomes from x-ray-induced aberrations under aerobic and anserobic conditions. (Ray-Chaudhuri et al., 1962)
- 1115 The genetical response of radiation spermatozoa to different types of radiation treatment. (Reddi, 1963)
- 1121 The frequency of XO males and induced autosomal crossovers after irradiation of Drosophila melanogaster males in air or commercial nitrogen. (Sävhaugen, 1961)
- 1122 The effect of oxygen concentration on the frequency of induced XO males and non-disjunction females after irradiation of Drosophila males. (Sävhaugen, 1961)
- 1150 Dose-dependence of radiation-induced mutation rate in Drosophila melanogaster depending on the stage sensitivity of the irradiated germ cells. (Traut, 1962)
- 1151 A study of dose-dependence of radiation-induced mutation rates in Drosophila melanogaster, allowing for the degree of maturity of the germ cells. (Traut, 1962)
- 1152 Dose dependence of the frequency of radiation induced recessive sex-linked lethals in Drosophila melanogaster. (Traut, 1963)
- 1162 The influence of oxygen on the frequency of radiation-induced chromosome aberrations in oocytes of Drosophila melanogaster. (Wind and Traut, 1961)
- 1163 The effect of roentgen rays and of high temperature upon the crossing over process. (Zakharov and Inge-Vechtomov, 1963)
- 1173 Cytogenetic investigations on the nature of dominant lethals induced in meiotic oocytes by gamma radiation and alkylating agents. (LaChance and Riemann, 1963)
- 1328 A quantitative study of lifetime sickness and mortality and progeny effects resulting from exposure to penetrating irradiation. (Gowen and Stadler, 1962)
- 1342 X-ray-induced mutations in Anopheles maculipennis. (Frizzi and Jolly, 1961)
- 1353-a The genetic basis of somatic damage produced by radiation in third instar larvae of Drosophila melanogaster. I. Death before maturity. (Ostertag, 1963)
- 1388 Chromosomal aberrations in a natural population of Chironomus tentans exposed to chronic low-level environmental radiation. (Blaylock, 1963)
- 1393 Chromosomal polymorphism decrease due to γ radiation on natural populations of Drosophila willistoni. (Cordeiro, 1961)

I-A-5 MITOTIC AND MEIOTIC STAGE SENSITIVITY

General

- 989* Carlson, J.G. THE IMMEDIATE CYTOLOGICAL EFFECTS OF IONIZING RADIATIONS. Bios 29, 3 (1958) 108-17.

"Immediate" effects appear as chromosome "stickiness", mitotic inhibition, chromosome aberration, and cell death. Neuroblast (grasshopper) appear particularly resistant to immediate lethal effects. The degree of stickiness appears to depend on the mitotic stage of the cell at irradiation, and on the dose given. The earlier the stage, the smaller the required dose. Mitosis in the neuroblast is highly sensitive to even very low doses. Irradiation-induced mitotic retardation is considered to be a temporary effect, from which the cells recover completely. Chromosome aberrations (single breaks, inversions, and translocations) and the ability of a cell to survive ionizing radiations are discussed.

- 990 Carlson, J.G. THE GRASSHOPPER NEUROBLAST CULTURE TECHNIQUE AND ITS VALUE IN RADIO-BIOLOGICAL STUDIES. Ann. N.Y. Acad. Sci., Wash. 95, 2 (1961) 932-40.

Review article. Since *Chortophaga viridifasciata* De Geer has no diapause it is a particularly convenient grasshopper. Interest has been centred on neuroblast mitosis and on the effects of different kinds of radiation on mitosis and on the structure and behaviour of various parts of the dividing cell. The technique described can be adapted to different kinds of radiation. In x- and γ -ray experiments the cells may be irradiated within the intact egg chorion and made into a hanging-drop preparation a selected interval of time later, or they may be irradiated in a hanging drop. For α -particles it is necessary to substitute thin mica for the cover glass. For β -radiation the embryo is oriented with the ventral side downward against a rubber hydrochloride membrane forming the bottom of a small dish containing culture medium and treated by inserting a P^{32} Bakelite plaque beneath it. After irradiation the embryo is mounted in a hanging-drop for observation. For ultraviolet radiation a quartz cover is substituted for the glass cover, and the neuroblasts on one side of the mid-ventral line of the embryo are shielded with film or black paper to serve as controls. The advantages and shortcomings of the method are described, also the effects of ionizing and ultraviolet radiations. 26 references.

- 991 Whiting, A.R. CONTRASTS IN RADIATION-INDUCED MUTATION RATES AT DIFFERENT MEIOTIC STAGES. p.183-95 in "Strahlenwirkung und Milieu (Radiation Effect and Milieu). Internationales Radiobiologisches Symposium in Montreux vom 28. Mai bis 3. Juni 1961". Fritz-Niggli, H., Ed. München, Urban and Schwarzenberg, 1962.

Review article. Results obtained with *Drosophila*, mouse and *Habrobracon* are emphasized, with reference made to relevant data on *Mormoniella*, *Apis*, *Sciara* and *Bombyx*. As the basis for comparison between stages and species, radiation-induced dominant lethal rates are used, when available. The article is broadly divided into sections on spermatogenesis, and oogenesis, with some mention of the oxygen effect in a brief paragraph at the end. Close on 80 references are given, ranging from 1932 to 1961.

- 992 Абелева, Э.А., Бельговский, М.Л., Потехина, Н.А. ВОЗНИКНОВЕНИЕ МУТАЦИЙ В НЕОБЛУЧЕННЫХ ХРОМОСОМАХ ЯЙЦЕКЛЕТОК, ОПЛОДОТВОРЕННЫХ ОБЛУЧЕННЫМИ МУЖСКИМИ ГАМЕТАМИ. *Радиобиология* 1, 1 (1961) 123-7.

Abeleva, E.A., Bel'govskii, M.L., Potekhina, N.A. OCCURRENCE OF MUTATIONS IN NONIRRADIATED CHROMOSOMES OF OVICELLS FERTILIZED BY IRRADIATED MALE GAMETES. *Radiobiology* 1, 1 (1961) 373-86. JPRS-10170, 18 Sept. 1961. Translation from *Radiobiologiya* 1, 1 (1961) 123-7.

Mutations in the chromosomes of non-irradiated ova of *Drosophila* fertilized with male gametes in non-irradiated chromosomes suggest a possible prolonged preservation and transmission of energy from one structure to another. The effect is not peculiar to the particular structure of the chromosome where such mutations occur. Contrary to observations on irradiated chromosomes, the effect (which had been subjected to 2000 r, at 336-384 r/min x-rays) is greater when sperm rather than spermatids have been irradiated. The general effect of radiation (sum of mutation frequencies in irradiated and non-irradiated chromosomes) is the same for irradiation of sperm or spermatid.

- 993 Abeleva, E.A., Potekhina, N.A. THE RADIATION SENSITIVITY OF VARIOUS STAGES OF SPERMATOGENESIS IN *Drosophila melanogaster*. (Abstr.) *Soviet Bloc Mainland China Tech. J.*, Ser. VI Bio-Sci. 61-11 145, 26 (1963) n.p. (With English summary)

The frequency of dominant lethals on repeated irradiation of *Drosophila* sperm and spermatids was studied to elucidate the reversibility of physiological damage and the mutagenic effects of repeated low dose radiation. Male F_1 hybrids of Algerian and Erebro strains (24 h old) received (1) 2400 r in one dose or 3×800 r at 1 1/2 h intervals, and (2) 400 r and 1200 r in a single dose or 3×400 r at 3 h intervals. In (1), since no difference was discerned between single and repeated doses, the interdose interval was increased to 3 h and the doses were changed to 1200 r maximum and 400 r minimum. As anticipated, repeated radiation did not affect the frequency of dominant lethals in the sperm. In spermatids the rate fell by 4.55%, suggesting recovery of the damaged chromosomes. The absence of effect after repeated radiation is not considered a decisive refutation of Russell's hypothesis. A linear relationship between dose and the frequency of dominant lethals is shown to exist up to 1000 r, and the similarity in the frequency pattern of dominant and recessive lethals is pointed out. The spermatid-sperm mutation rate ratio increases with dose reduction, changing from 3:4 at 1000 r to 4:5 at 400 r and to 5 at 20 r. Small doses exert, therefore, a large effect on spermatids. These effects are discussed in relation to man and the length of the various stages of spermatogenesis. The danger of damage during very short, but highly radiosensitive stages is emphasized. There are 2 tables. (Auth.)

- 994 Baldwin, W.F. LATENT RADIATION DAMAGE AND SYNCHRONOUS CELL DIVISION IN THE EPIDERMIS OF AN INSECT. III. SPONTANEOUS REVERSAL OF EFFECTS LEADING TO DELAY DURING MITOSIS. *Rad. Res.* 14 (1961) 426-31.
- Moulting in the insect *Rhodnius*, order Hemiptera, is initiated by a single meal of blood. After the meal, and in response to a stretching stimulus from the abdomen, neurosecretory cells of the insect brain produce a secretion that activates the thoracic gland, which produces the moulting hormone. Whole-body irradiation was found to delay initiation of division in nymphs. Exposures of 9000 r from a 2-MeV x-ray machine were given. Results of studies on 4th-stage nymphs irradiated over the abdomen only indicate the spontaneous reversal of a part of the latent radiation damage. Reaction mechanisms involved are discussed.
- 995 Baldwin, W.F. NON-REPAIRABLE AND REPAIRABLE SOMATIC EFFECTS OF IRRADIATION IN INSECTS. p.7 in "Radiation Biology in Canada 1962-63". CRB-1129, AECL-1701, Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 1963. 60p.
- To determine the precise relationship between the delayed expression of radiation injury and the time of onset of post-irradiation cell divisions, the effects of irradiation on the epidermal cells of the blood-sucking insect *Rhodnius* are being studied. Cell division in the epidermis underlying the outer cuticle of this insect occurs only at 5 d after feeding on blood and the divisions are essentially synchronous throughout the whole epidermal layer. Thus it is possible to irradiate in the non-dividing state and then force the cell divisions to occur at any desired time after the exposure by allowing the insect to feed. (From auth.)
- 996 Borstel, R.C. von. THE GENETIC BASIS FOR X-RADIATION-INDUCED MITOTIC INHIBITION. (Abstr. 21) *Rad. Res.* 14 (1961) 453.
- In *Drosophila*, most of the embryonic deaths from x-irradiation of the sperm occur during the first few mitotic divisions after meiosis. An easily recognizable syndrome follows: Numerous (usually 8 to 16, although the ranges are from 3 to about 100) polyploid nuclei are found throughout the egg. Many of the nuclei appear to be lying in spindles with chromosomes disoriented. It has been shown that this type of death cannot be accounted for by loss of chromosomes, inactivation of nucleoli, nor by loss of chromosome parts. The author believes that chromosomal bridges, derived either by radiation or genetically, act not through eventual loss of essential genes by bridge-breakage, but by drastic slowing of the rate of mitosis. Unfertilized *Drosophila* eggs will not proceed in development as far as eggs fertilized with irradiated sperm. This mitigates against the possibility that eggs fertilized by irradiated sperm are behaving like unfertilized eggs. (From abstr.)
- 997 Borstel, R.C. von. STAGE SENSITIVITY TO X-RADIATION DURING MEIOSIS AND MITOSIS IN THE EGG OF THE WASP *Habrobracon*. (Abstr. B1A996) p.59-60 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.
- A dose of 500 r was chosen since it approximates the 50% hatchability dose of eggs in the 1st meiotic metaphase in the female. Eggs older than 1 min from oviposition were discarded. To slow down the rate of nuclear division the embryos were kept at 20°C until irradiated. Control embryos were fixed in cold Kahle's fixative and stained to permit accurate cytological staging. Each embryo was timed to within 1 min. Data were collected for metaphase I of meiosis, anaphase I through anaphase II of meiosis, post-anaphase II and pronucleus, prophase I of mitosis, metaphase I of mitosis, and later stages.
- 998 Borstel, R.C. von., Amand, W.St. STAGE SENSITIVITY TO X-RADIATION DURING MEIOSIS AND MITOSIS IN THE EGGS OF THE WASP *Habrobracon*. p.87-100 in "Repair from Genetic Radiation". Sobels, P.H., Ed. Oxford, Pergamon Press. 1963.
- After reviewing reported radiation effects on (pre-oviposition) eggs the authors describe radiation effects of a dose of 500 r administered post-oviposition. Problems related to stage sensitivity during meiosis and during karyokinesis are discussed, also genetically non-transmissible damage and a "nuclear re-activation" effect, demonstrated with ultraviolet radiation. Five types of nuclear damage can be distinguished (I-death after one or several nuclear divisions; II and III - death after numerous nuclear divisions; IV-death and pyknosis soon after irradiation; V-dominant lethality expressed in eggs after irradiation in the gonial stage). The syndromes and probable basis for such damages are discussed.
- 999 Carlson, J.G. STUDIES OF EARLY EFFECTS OF RADIATION ON CHROMOSOMES AND MITOSIS. (Abstr. B1A274) p.30-1 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

The proposed study will consist of three main projects: Electron microscope studies of the early morphological effects of x-rays on the internal structure of the chromosome. Grasshopper neuroblasts will be fixed at different time intervals up to 1 h after x-raying to discover whether changes in the internal structure of the chromosome can be detected. Studies to determine whether recovery from x-ray-induced chromosome damage is accompanied by DNA synthesis. Selected neuroblasts will be irradiated in vitro in any of 15-20 identifiable stages of the mitotic cycle, exposed to radioactive precursors at a desired stage for a given length of time, fixed and made into squash preparations when they are in the desired stage, and autoradiographed. Effects of certain wavelengths of monochromatic uv radiation on incorporation of tritiated precursors into the grasshopper neuroblast chromosome. The methods used will be similar to those of the preceding project. In addition to DNA synthesis, it is our intention to study also protein synthesis by means of radioactive precursors.

- 1000 Chandley, A.C., Bateman, A.J. MUTAGENIC SENSITIVITY OF SPERM, SPERMATIDS, SPERMATOCYTES, AND SPERMATOGONIA IN Drosophila melanogaster. Heredity 15 (1961) 363-75.

Freshly eclosed males were given 1000 r x-rays and then mated continuously with 2 females/male/d. Mating on days 2, 5, 8 and 11 from irradiation were analysed for dominant lethals, translocations, autosomal and sex-linked recessive lethals, deleted X's and induced crossing over. Day 5 showed the peak sensitivity for translocations and recessive lethals. There was a plateau including days 5 and 8 for dominant lethals. Day 8 showed the peak sensitivity for deleted X's and for induced crossing over which in the latter case continued at a high level subsequently. A low incidence of crossing over on days 6 and 7 indicates that these must represent a diploid stage (probably spermatocytes) at irradiation. It is thus possible to identify the main sampling times with the irradiated stages then being sampled: day 2 - mature sperm; day 5 - early spermatids; day 8 - early spermatocytes or late spermatogonia; day 11 - spermatogonia. (Auth. summ.)

- 1001 Chandra, H.S. INVERSE MEIOSIS IN TRIPLOID FEMALES OF THE MEALY BUG, Planococcus citri. Genetics 47, 8 (1962) 1441-54.

The sequence of meiotic divisions, the first usually being reductional and the second, equational, has been demonstrated to be inverted in a mealybug, using triploid females. Such females were prepared routinely by irradiating adult males with 90 000 rep γ -rays (Co^{60} -source). At first anaphase in the triploid there was always a 15:15 separation of chromatids; the diffuse nature of the kinetochore permits such a numerically equational separation. Reduction is accomplished in the 2nd division in which there is evidence for re-association or "secondary pairing" of the homologous chromatids into triads or dyads in most of the oocytes. The maternal contribution to the zygote following $3N \times 2N$ matings was studied in 272 embryos. There was a significant bias in distribution in favour of lower chromosome numbers. It is suggested that the bias is probably real, and based on a definite tendency of triploid mothers to deliver fewer chromosomes to the egg than to the second polar body.

- 1002 Clayton, F.E. EFFECTS OF X-RAY IRRADIATION IN Drosophila virilis AT DIFFERENT STAGES OF SPERMATOGENESIS. p.345-73 in "Studies in Genetics. II. Research Reports on Drosophila Genetics, Taxonomy and Evolution". Wheeler, M.R., Ed. Austin, The University of Texas. 1962.

Dominant lethals and translocations from x-ray exposure of larvae, pupae, and adults were determined for successive 2-d mating periods. Results indicated that spermatids are highly susceptible to radiation damage; meiotic stages and mature spermatozoa are also sensitive periods, with greatest resistance to chromosome breakage among spermatogonia. Histological analysis of testes collected at intervals following irradiation of larvae, pupae, and adults revealed decreases in all types of meiotic cells followed by recovery to the control level in some tests. Radiation by 1089 r resulted in delay in emergence of adults by ~2 d. Phase-contrast microscopy, aceto-orcein smears, and histological analysis of sections from adult males were used for studying spermatogenesis. Cell counts from adults indicate a 2-d cycle in meiosis until the males are sexually mature. There appear to be steadily diminishing peaks in the mean numbers of primary spermatocytes in pupae just before emergence, and in adults of 2, 4, and 6 d. Spermatozoa of D. virilis are not motile or functional until the 8th day; females were not inseminated and no fertile eggs recovered prior to this.

- 1003* Davis, D.G. INCREASED RECOMBINATION FROM Drosophila FEMALE X-RAYED BEFORE THE PRESUMED ONSET OF MEIOSIS. Proceedings of the 57th Annual Meeting of the North Carolina Academy of Science, 1960. J. Elisha Mitchell sci. Soc. 76, 2 (1960) 193.

- 1004 Ives, P. T. SOME EFFECTS OF COBALT-60 GAMMA RADIATION ON PREMEIOTIC SPERMATOGENIC CELLS IN Drosophila melanogaster. (Abstr.) Amer. Zool. 1 (1961) 361.
- 1005 Ives, P. T. PATTERNS OF SPONTANEOUS AND RADIATION INDUCED MUTATION RATES DURING SPERMATOGENESIS IN Drosophila melanogaster. Genetics 48, 8 (1963) 981-95.
- Daily patterns of mutational response to γ -rays were determined for 3 types of young, adult, heterozygous, Oregon-R males which were mated exhaustively during days 1 to 12 after irradiation. Dose of 250 r, 500 r, and 1 kr were tested for the production of dominant visible and sex-linked hemizygous mutations, and 1 kr for Y and autosomal translocations. Translocations were also scored in tests of irradiated mature sperm, and of sperm maturing 5 to 6 d later, after doses of 250 r, 500 r, 2 kr and 4 kr. A linear relationship with dose is indicated for the rates of all types of induced point mutations in sperm from days 1-8. In pre-meiotic stages of spermatogenesis the relationship varies between dosage levels and between the types of heterozygous males tested. After 1 kr, day-5 sperm showed 3.7 times more sex-linked mutations than appeared in sperm from days 1 and 1-3 and day-6 sperm showed 11.6 times more translocations. Changes in mutation frequency (days 1-8) thus appear to reflect changes in the rate at which both point mutations and chromosome rearrangements occur in the various stages of spermatogenesis from meiosis to maturity. The rate of translocations increases at ~ 1.6 power of the increase in dose in both mature sperm and sperm maturing 5-6 d after irradiation, and the rate of point mutations increases clearly at both of those times. This supports the view that the mutation process does not change during the meiosis-to-maturation period of spermatogenesis. At the time of peak response in meiosis-spermiogenesis, as well as in mature sperm, after 250 r to 1 kr, dominant visibles appear to be a mixture of point and position-effect mutations. Peak mutation rates appear to be associated with specific stages in spermatogenesis. (From auth. summary)
- 1006 Kvelland, I. RADIOSENSITIVITY IN DIFFERENT STAGES OF SPERMATOGENESIS IN Drosophila melanogaster. Hereditas 48 (1962) 220-42.
- The relative radiosensitivity in different stages of spermatogenesis in D. melanogaster was investigated by studying the sensitivity pattern for different kinds of mutations, i.e. visibles, sex-linked lethals, II-III translocations, and induced crossovers in males. The time required for spermiogenesis, i.e. the time from meiosis to fully mature sperm was considered to be about 6-7 d at 25°C in adult males. The following peaks in frequency were obtained, stated as number of days after irradiation: recessive sex-linked lethals - 5; translocations - 7; visibles - 5; periods of excessive sterility (under experimental conditions) - 7 and 8, or 8 and 9. The radiosensitivity of fully mature sperm was seen to be somewhat higher than that of nearly mature sperm. With further immaturity an increasing sensitivity was observed for all effects studied up to 5 and 6.
- 1007 Lindsley, D. L., Edington, C. W., Halle, E. S. von. THE EFFECT OF GAMETIC GENOTYPE ON THE RADIATION SENSITIVITY OF Drosophila SPERM. p. 63-76 in "Repair from Genetic Radiation Damage". Sobels, F. H., Ed. Oxford, Pergamon Press. 1963.
- Irradiation of Drosophila males may produce a shift in the ratios of the different genotypes recovered among the progeny. A method was developed for treating progeny ratios following paternal irradiation as the ratio of two survival functions, where survival refers to the ability of a mature sperm of a particular genotype to produce an adult fly in the next generation. Although chromosome loss and among-experiment variability contribute imprecision to the model as it stands, the following tentative conclusions were drawn: X-bearing sperm and Y-bearing sperm exhibit virtually identical sensitivities to radiation, and sperm with two sex chromosomes are more sensitive than sperm with one sex chromosome which are in turn more sensitive than sperm lacking a sex chromosome. The portion of the proximal heterochromatin lying between the right breakpoints of $\text{In}(1)\text{sc}^4$ and $\text{In}(1)\text{sc}^6$ or $\text{In}(1)\text{sc}^{51}$ has no effect on the sensitivity of X-bearing sperm when it is in its normal proximal position, but when it is shifted to the distal terminus of the X chromosome, as it is by $\text{In}(1)\text{sc}^8$ or $\text{In}(1)\text{sc}^{51}$, it causes an increase in the sensitivity of the X-bearing sperm. Closing the X chromosome, i.e. using a ring-shaped X, causes a large increase in the sensitivity of X-bearing sperm. (Auth.)
- 1008 Nelson-Rees, W. A. NEW OBSERVATIONS ON LECANOID SPERMATOGENESIS IN THE MEALY BUG, Planococcus citri. Chromosoma 14 (1963) 1-17.
- In irradiation experiments, young 2nd instar males were placed in gelatine capsules and treated with 1000 r x-rays, at 418 r/min. They were fixed 41 h later. Observations were made by phase microscope during actual cell division, as well as on stained and unstained squash preparations. Examination of the 2nd spermatogenic division of the mealy bug, P. citri (Risso), a lecanoid coccid, has revealed hitherto unknown

spindle activity of the euchromatic set of chromosomes during anaphase II. An initial large half spindle elaborated by the hetero-chromatic chromosomes in early metaphase, gives way to a less pronounced, but clearly visible bipolar spindle involving both sets of chromosomes at early anaphase. There is no lengthening of the spindle or cell, but the separation of the chromosomes occurs around the periphery of the cell with the aid of interzonal activity. The activity participation of the euchromatic chromosome during the separation is furthermore inferred by the formation of bridges resulting from euchromatic-hetero-chromatic translocations. (Auth.)

- 1009 Oster, I.I., Pooley, E. METHODS FOR ESTIMATING DIFFERENTIAL RADIOSENSITIVITY. (Abstr. 5.37) p.67-8 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September, 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

A combination of different techniques has permitted cytogenetical analyses of cells representing homogeneous stages of development at the time of treatment. These methods include the use of our so-called multi-purpose stocks (i.e. strains which allow for the detection of several different types of genetical damage in the offspring of the same treated individual), histological examination of the germ tract of the treated individuals, and a sampling technique that involves the treatment of immature stages which contain a preponderance of germ cells in a similar stage of development. The clear-cut pattern of germ cell radiosensitivity as regards various types of genetical damage which has emerged for *Drosophila* is in general agreement with that obtained more recently for the mouse by Dr. L.B. Russell. This parallelism suggests that the mechanism(s) underlying differential radiosensitivity may be quite widespread. In addition to a comprehensive report of the results obtained with radiation, comparisons are made with the data obtained by treating the reproductive cells with chemical mutagens. (From abstr.)

- 1010 Parker, D.R. ON THE NATURE OF SENSITIVITY CHANGES IN OÖCYTES OF *Drosophila melanogaster*. p.11-19 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Changes in sensitivity in stages 7 and 14 of primary oöcytes of *Drosophila* were studied with special attention on detachments of attached X chromosomes and the induction of dominant and recessive lethals. Changes in sensitivity between stages 7 and 14 are not simple. In the case of rearrangement, the increase involves a disproportionate increase in the value of k , and the total increase is underestimated due to the greater proportion of inviable aneuploids occurring in the later stage. The increase in sensitivity is accompanied by much less rapid rejoining, and this may be the principal basis for the increase in the value of k , through a lowering of the probability of restitution. In the case of dominant lethals, there is a change in the mode of their production, it being a two-hit process in the early stage, becoming one-hit later. The delay in rejoining may be the primary cause, dominant lethals in stage 14 arising from breaks that do not rejoin or rejoin. The increase in frequency of recessive lethals seems primarily dependent on the increased frequency of two-hit events, hence may be due to an increased production of chromosomal aberrations, perhaps small deficiencies. (NSA 18:1964, 11829)

- 1011 Rai, K.S. X-RAY-INDUCED MITOTIC CHANGES AND MORTALITY IN *Aedes aegypti* LINN. (Abstr.) *Genetics* 47, 8 (1962) 977.

See 1013.

- 1012 Rai, K.S. RADIOSENSITIVITY OF THE MITOTIC CYCLE OF *Aedes aegypti*. (Abstr. 206) *Bull. ent. Soc. Amer.* 8, 3 (1962) 162.

Following exposure to x-rays, the number of dividing cells in whole brains of *Aedes aegypti* larvae was scored. Initially, all doses suppressed mitotic activity almost completely. Later, there was a great increase in cell division, the rate at 500 and 1000 r being more than double the rate in untreated controls.

- 1013 Rai, K.S. A CYTOGENETIC STUDY OF THE EFFECTS OF X IRRADIATION ON *Aedes aegypti*. *Caryologia* 16 (1963) 595-607.

Cytogenetic effects of x-rays (500, 1000, 2000, 4000 r) on the NIH strain of *Aedes aegypti* L. were studied. Larvae were reared under controlled conditions and were irradiated 6 d after hatching, at a time when most were in the early 4th instar. 5-10 larvae were fixed for cytological examination at intervals of 0, 1½, 6, 12, 18, 36, and 72 h after irradiation. Mitotic chromosomes were studied from squash preparations of larval brains stained with acetolactic orcein. Mitotic activity was measured in terms of the total number of dividing cells per brain. Initially, x-irradiation inhibited cell division. Mitotic activity was almost completely suppressed 1½ h after irradiation. After a time (depending on dose used), this

effect was replaced by a great increase in mitotic activity. Twelve hours after irradiation, the larvae exposed to 500 and 1000 r showed about twice as many mitotic figures as did the unirradiated material. The increase in mitotic activity at higher doses was less extreme and took longer to occur. Among the chromosomal aberrations noted were deletions, inversions, exchanges, rings,acentrics and anaphase bridges. Explanations for the induction of these aberrations were discussed. A relation existed between the dose received and the developmental stage at which an individual died. The higher the dose, the earlier the death occurred. Furthermore, 2000 r or more resulted in almost 100% mortality. Some possible causes of x-ray-induced mortality and changes in fertility were suggested. (Auth.)

- 1014 Ratty, R.J. A COMPARISON OF MUTATION RATES IN MALE AND FEMALE PRE- AND POSTMEIOTIC GERM CELLS OF *Drosophila*. (Abstr.) *Genetics* 46, 8 (1961) 891-2.

This study has attempted to determine whether the mutation rates of the yellow (y), white (w), split (spl), and forked (f) loci contained in the white-mottled-4 (w^{m4}) chromosomes are comparable in male and female germ cells. The work reported herein is based upon the examination of 244106 F_1 of both sexes derived from irradiated w^{m4} males and 172000 F_1 of both sexes derived from irradiated w^{m4} females. White-mottled-4 parents were mated to y w spl f flies following exposure to 3000 r and the progeny were scored for the occurrence of viable and lethal mutations. The parents were subcultured to new media every three days for a maximum of 24 d. A comparison of the mutation rates indicates an excess of y, w and w-N mutants in ova whereas more N(w*) mutants were found in sperm. A comparable number of f mutants was found among the progeny of irradiated males and females. In the period 4-12 d after irradiation, an excess of all types of mutations was found in spermatocytes. However, subsequent to this period no mutants were found following the examination of 35873 females derived from irradiated males, whereas 10 y, one w, one w-N and 10 f mutants were recovered from a comparable number of progeny of irradiated w^{m4} females up to 24 d subsequent to the time of irradiation. It would appear that both viable and lethal mutations are either produced more readily in premeiotic female than male germ cells or they are transmitted with greater facility.

- 1015* Sado, T. HISTOLOGICAL STUDIES OF RADIATION SENSITIVITY OF SPERMATOGENIC CELLS OF THE SILKWORM (Preliminary note). *Genetics, Japan* 9 (1958) 101-2.

- 1016 Sado, T. SPERMATOGENESIS OF THE SILKWORM AND ITS BEARING ON THE RADIATION INDUCED STERILITY. p.186-50 in "Proceedings of the Symposium on Genetic Effect of Radiation, Mishima, 7-8 November 1960", *Jap. J. Genet.* 36, Suppl. The Genetics Society of Japan. 1961. (In English).

The correlation between the developmental stages of larvae and the germ cell stages in the testis was investigated in order to obtain basic knowledge required for mutagenesis work with the silkworm. The duration of each stage in spermatogenesis of the silkworm was estimated from the time table of the 1st appearance of cells in successive stages. It was noted that meiotic prophase takes about 10 d but late meiotic stages proceed within a short time. Results of the histological examinations of irradiated testes of the silkworm were in good agreement with those of previous workers on different animals, showing an extreme sensitivity of secondary spermatogonia to the killing effect of x-rays. Spermatocytes at late meiotic stages were shown to be more sensitive to irradiation than those at synaptic and pachytene stages. In the silkworm sterility due to the destruction of late spermatogonia is not detectable, even though the cells are easily killed by radiation. Pronounced sterility after irradiation in the early 5th instar occurs as a result of damage to late meiotic stages, especially in late prophase. These findings have been discussed in relation to similar ones in mice and *Drosophila*, and it has been shown that a consistent picture of radiation induced sterility in animals can be inferred.

- 1017* Sävhaugen, R. THE RELATION BETWEEN THE RATE OF INDUCED TRANSLOCATIONS AND TREATED CELL STAGES IN MALES OF *Drosophila melanogaster*. *Hereditas* 46 (1960) 651-87.

The present paper deals with the relation between induced translocations and the treated cell stages in *Drosophila* males. By use of a dual-purpose stock it was possible to study the frequency of induced XXO females in F_1 and the rate of induced translocations in F_1 . The observed frequency of induced XXO females parallels very well earlier studies with induced XO males and induced non-disjunction between the paternal X and Y chromosomes. The occurrence of non-disjunction females was used as an indication of cells treated prior to anaphase I. It was shown that the frequency of induced translocations varies with the mating periods, which, according to the brood technique, represent successively younger germ cells. The peak of translocations was observed on the 6th day after irradiation. It is suggested that the cells which become available for insemination during this mating period chiefly correspond to cells treated as early spermatids. Germ cells irradiated during early meiosis (prior to anaphase I) yield few translocations (8th

day after treatment). The reduction in the rate of induced translocations is even more pronounced on the 10th or 14th day after irradiation. It is evident that there exists a difference in the observed pattern of sensitivity to irradiation when different types of aberrations are used as an indication of induced genetic damage. No effect is observed upon the rate of induced translocations when the dose is delivered in two fractions with an interval of 1 h. Thus an interval of 1 h was not long enough to allow rejoining of chromosome breaks giving rise to translocations. (Auth.)

- 1018 Sävghagen, R. THE RELATION BETWEEN X-RAY SENSITIVITY AND STAGES OF DEVELOPMENT OF TREATED CELLS IN SPERMATO- AND SPERMIOGENESIS OF Drosophila melanogaster. Hereditas 47 (1961) 43-68.

By using a dual-purpose stock it was possible to study the frequency of induced XO males and induced non-disjunction between the paternal X and Y chromosomes in Drosophila after 0 to 1 and 3 to 4-d-old y¹⁶; sc⁴ Y males were irradiated (1100 r) and mated to virgin y w sn females in successive mating periods. The first mating period was delimited to 0 to 4 h after irradiation but from the 4th day and on each mating period consisted of 24 h. It is shown that irradiation of Drosophila males causes non-disjunction between the paternal X and Y chromosomes. Hence, the occurrence of an increase in the frequency of non-disjunction in sperm ejaculated during a limited period after irradiation must be taken as an indication that those spermatozoa were in meiosis at the time of treatment. Factors which may influence this cell stage/sensitivity relationship are discussed. (Auth.)

- 1019 Sävghagen, R. CELL STAGES AND DIFFERENTIAL SENSITIVITY TO IRRADIATION IN MALES OF Drosophila melanogaster. p.343-57 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

By simultaneous studies of paternal non-disjunction and a certain type of chromosome aberration in Drosophila the brood pattern was correlated with the early meiotic stages in spermatogenesis, prior to anaphase I. It was shown that the cells treated in meiosis became available for insemination during the 7-10th day after irradiation. The peak of sensitivity to irradiation measured through induced XO males of XXO females, coincides with the peak of induced paternal non-disjunction and thus with cells treated in early meiosis. About the same sensitivity pattern is obtained after irradiation of 0-1 and 3-4-d-old males. There is, however, a difference in the amplitude of sensitivity. Thus the frequency of both XO males and induced non-disjunction females is much lower in experiments with 3-4-d-old males. When comparing the different methods used in order to demonstrate the genetic effects (damage) of irradiation it is evident that there is not only a marked difference in sensitivity to irradiation between various stages of spermatogenesis in Drosophila, but also a difference in sensitivity pattern depending on the type of aberration studied. Hence the differences in the sensitivity patterns reflect the relationship between the mechanisms at work in producing different kinds of damage and the cell stage treated. The relationship between induced genetic changes and oxygen concentration in various stages of spermat- and spermiogenesis was studied. The effect after irradiation in nitrogen atmosphere reveals that anoxia exerts the most striking influence upon the yield of XO males during the period of highest sensitivity to x-irradiation. Irradiation in commercial oxygen affects the sensitive stages in different ways in 0-1 and 3-4-d-old males. In the younger males there is a lower effect than that obtained after irradiation in air, while in 3-4-d-old males there is a correspondingly higher rate of chromosome losses. (Auth.)

- 1020 Schmid, W. DIFFERENTIAL SUSCEPTIBILITY OF SPERM AND SPERMATIDS TO IONIZING RADIATIONS. Amer. Nat. 95 (1961) 103-11.

A hypothesis is offered to explain the differential susceptibility of sperm and spermatids to ionizing radiations. In Drosophila, a given x-ray dose causes up to several times more genetic mutations in spermatids than in sperm. Further, the two kinds of cells show different dose-effect curves, react differently to changes in the oxygen tension during x-irradiation, but behave very similarly to neutron irradiation. In sperm the condensed chromosomes are packed tightly together in the small sperm heads, while the chromosomes of spermatids, located in regular nuclei, are separated from each other by some space within the karyolymph. The proposed hypothesis assumes that the diffusing secondary radiochemical products of ionizations occurring in the immediate neighbourhood of the chromosomes cause a considerable amount of chromosomal damage, in addition to the effects due to ionizations occurring within the structures of the chromosomes themselves. The additional space is present around the chromosomes of spermatids as in most other types of cells but is practically missing in the exceptional cell-type represented by sperm. Various differences in the reaction of spermatids and sperm may thus be explained. (From auth. summary)

- 1021 Silzyska, H. HETEROGENEITY AMONG SPERMATOGONIA OF *Drosophila melanogaster* IN SENSITIVITY TO X-RAYS. Genet. Res. 4 (1963) 445-56.

Sensitivity of *D. melanogaster* male germ-cells to chromosome breakage by x-rays was measured by the structural changes found in the salivary gland chromosomes of larvae from irradiated fathers and untreated mothers. The genetical effectiveness of irradiation on the same males was measured by the frequency of sex-linked lethals. Assessed by the overall percentage of germ-cells carrying structural changes, sensitivity follows the well-known pattern: it is highest in spermatids and decreases over spermatozoa and spermatocytes to spermatogonia. This overall sensitivity was analyzed on three levels. The fact that the sensitivity of spermatogonia varies both between and within individual males was tentatively attributed to the presence or absence of spermatogonial mitoses. (Auth.)

- 1022 Strangio, V.A. RADIOSENSITIVE STAGES IN THE SPERMATOGENESIS OF *Drosophila melanogaster*. Nature, Lond. 192 (1961) 781-2.

A preliminary account is given of experiments designed to detect simultaneously complete loss of X or Y chromosomes, deletion in the Y chromosome, and non-disjunction between X and Y chromosomes. A new, doubly marked Y chromosome stock designated sc⁸Yb⁸ is used. After x-irradiation with 1000 r, males with a wild-type X chromosome and the doubly marked Y are mated daily to 3 females homozygous for the X chromosome markers yellow, apricot, echinus. On the assumption that the determination of non-disjunction will occur only at or before anaphase in the first meiotic division, the results indicate that the 7th brood in particular represents treated pre-meiotic stages and confirm the high sensitivity of meiotic and immediately pre-meiotic stages to the mutagenic effect of x-rays. (NSA 16: 1962, 2911)

- 1023 Strangio, V.A. RADIOSENSITIVITY DURING SPERMATOGENESIS IN *Drosophila melanogaster*. Amer. Nat. 96, 888 (1962) 145-50.

Males carrying the dominant Bar (B^S) marker on the Y chromosome are x-rayed (800 r) and then mated afresh to virgin Bar-reverted B⁺asc (modified Muller-5) females on each of the 12 d following irradiation. Assuming that this brood order reflects inversely the sequence and duration of the individual stages in sperm formation, the experimental method permits simultaneous detection of sex-linked recessive lethals, sex chromosome loss and primary non-disjunction of the sex chromosomes induced in male germ cells which were at different points in the maturation cycle at the time of irradiation. If the onset of induced primary non-disjunction is accepted as a criterion of irradiated primary spermatocytes, the results confirm earlier findings that hypersensitivity to the induction of sex-linked recessive lethals occurs in the post-meiotic spermatid stage while peak sensitivity for sex-chromosome loss occurs in spermatocytes. (Auth.)

- 1024 Tazima, Y. CONSIDERATIONS ON THE CHANGES IN OBSERVED MUTATION RATES IN THE SILKWORM AFTER IRRADIATION OF VARIOUS STAGES OF GAMETOGENESIS. p. 50-64 in "Proceedings of the Symposium on Genetic Effect of Radiation, Mishima, 7-8 November 1960". Jap. J. Genet. 36 Suppl. The Genetics Society of Japan. 1961. (In English),

The criteria employed in the comparison of radiation effects were fertility, fecundity, dominant lethals, and recessive mutations at marked loci with genes that express their action at very early stages of the life cycle. The results are mostly consistent with existing data on *Drosophila* and mouse. However, extreme sterility was observed when germ cells were (x-) irradiated at late meiotic prophase (see effects on late spermatogonia in mice). Two types of dose-rate dependence in radiation-induced mutation rate occurred at different stages of early larval development. The technique used allowed mutants to be detected at very early stages of embryonal development. It appears that gross chromosomal aberrations reduce the detectability of viable mutations in later stages of development. The second peak in mutation frequency occurred around the time of hatching, in both sexes, when almost all germ cells are presumably in the primordial stage. (It should be noted that it is characteristic of *Bombyx mori* that all germ cells develop almost synchronously)

- 1025 Tazima, Y., Kondo, S. DIFFERENTIAL RADIATION-SENSITIVITY OF GERM CELLS AS A POSSIBLE INTERPRETATION OF SEX DIFFERENCE IN DOSE-RATE DEPENDENCE OF INDUCED MUTATION RATES IN THE SILKWORM. p. 237-52 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press, 1963.

In order to elucidate the difference in sex with respect to mutation response of silkworm germ cells, experiments were carried out on silkworms. The dose-mutation frequency relationship was followed up by irradiating spermatogonia and oögonia with acute (316 ~333 r/min) or chronic (0.069 ~0.208 r/min)

irradiation at the earliest larval stage. The shape of the dose-frequency curves was different between spermatogonia and oögonia. In oögonia a linear relationship was clearly observed for both acute and chronic irradiation, while in spermatogonia the frequencies for acute and chronic exposures increased with the increase of dose more rapidly than expected for linearity; the dose rate difference becoming smaller in the high dose range. Survival of irradiated germ cells was estimated by analysing theoretically the frequency distribution of the number of recovered mutants per mating pair. Comparison in LD₅₀ between spermatogonia and oögonia clearly showed that spermatogonia are twice as sensitive to radiation as oögonia. It was concluded that the dose-rate dependence of radioinduced mutation rate is closely correlated to the killing effect of radiation, and hence to the sensitivity of germ cells. The significance of these phenomena in the process of recovery of primary mutational damage is discussed. (NSA 18:1964, 11839)

- 1026 Thompson, P.E. THE EFFECT OF ASYNAPSIS ON MUTABILITY IN THE TESTIS OF Drosophila. (Abstr.) Genetics 46, 8 (1961) 904.

In males of Drosophila, normal chromosomes paired with inverted chromosomes have shown higher rates of spontaneous and x-ray induced mutation than isogenic controls. This difference in mutability is most striking in meiotic stages, where its magnitude after irradiation implies a synergistic interaction of treatment and the genetic constitution. The effect is limited to those chromosomes in which structural heterozygosity exists. — Two alternative hypotheses toward an underlying mechanism of increased mutability have been advanced: an effect of stress or torsion associated with inversion-pairing configurations, and an effect of the partial asynapsis that must accompany structural heterozygosity. A test of the effect of asynapsis without torsion is made possible by the use of SM5, a complex intrachromosomal rearrangement having 13 inversion or transposition breaks, which does not pair appreciably with its homologue. Preliminary results indicate high mutability of the unsynapsed homologue of SM5 and suggest that homologous pairing itself is an important factor in mutation, presumably by some facilitation of repair.

- 1027 Thompson, P.E. ASYNAPSIS AND MUTABILITY IN Drosophila melanogaster. Genetics 47 (1962) 337-48.

From analysis of salivary gland configurations and patterns of non-disjunction, it is estimated that highly rearranged Second Multiple 5 (SM5) chromosome does not pair extensively with its homologue. The frequency of chromosome II lethal mutations was significantly higher among sperm from asynaptic SM5/+ males (19.5%) than among sperm from control males (8.6%) 6-8 d after treatment with 1000 r of x-rays. These sperm batches are interpreted as having been in or near meiosis at the time of irradiation. This sensitivity of SM5/+ males was found not to extend to the X chromosome after irradiation indicating that such males do not have an inherently high mutability. The rate of spermiogenesis or sperm maturation in SM5/+ males and control males was compared by scoring induced crossovers, fecundity and egg hatchability during single-day mating periods after irradiation. No difference in the pattern of these effects was observed, so that the maturation time of both groups of males is apparently the same. The interpretation that asynapsis is an important factor during meiosis is supported by these findings. It is suggested that during meiosis the synapsis of homologous chromosomes favours the repair of chromosomal disruptions over the formation of rearrangements, and that asynapsis may greatly increase the frequency of lethal mutations. (Auth. summary)

- 1028 Thompson, P.E. SYNAPTIC MODIFICATION OF DOMINANT LETHAL FREQUENCIES AFTER IRRADIATION OF THE Drosophila TESTIS. (Abstr.) Genetics 47, 8 (1962) 991.

Increases in the mutability of unpaired chromosomes have led to the interpretation that the synapsis of homologous chromosomes is a major factor in the repair of radiation induced chromosomal damage. This hypothesis is substantiated by the present data on the production of dominant lethals among males in which complex structural heterozygosity (presence of multiple inversion SM5) has created almost total asynapsis of one major pair of chromosomes. Egg development among 1-d broods from such males after x-ray treatment gave evidence of an appreciable increase in dominant lethals of meiotic origin, in comparison with males lacking structural heterozygosity. The brood pattern of dominant lethals from irradiated control males shows a plateau of maximum frequency from early meiosis to spermatid stages, i.e., among sperm sampled from the 5th to the 8th day after irradiation. Broods from irradiated SM5 males gave similar frequencies for premeiotic and postmeiotic stages, including the 5th and 10th brood periods, but during days 6-8 about twice as many dominant lethals were scored among these lines. If dominant lethals may be equated with highly aberrant rearrangement or loss of chromosome fragments, asynapsis appears to contribute markedly to gross genetic damage during meiosis.

- 1029 Whiting, A.R. A COMPARISON OF VISIBLE MUTATION RATES IN *Habrobracon* EGGS X-RAYED IN FIRST MEIOTIC METAPHASE OR PROPHASE. (Abstr.) p.117 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.
- The extreme difference in sensitivity to x-rays of *Habrobracon* eggs irradiated in first meiotic metaphase or prophase as measured by dominant and recessive lethal mutations has been established by studies previously published. This difference has now been found to apply to visible mutations as well. Two methods of testing were used: (a) the same dose, 1100 r, for both stages and (b) 1100 r for metaphase and 25 000 r for prophase, doses giving comparable lethal rates. After 1100 r, for eggs exposed in metaphase, percentage of visible mutations was 5.35, for those exposed in prophase, 0.48. After 25 000 r, percentage was 6.18 for prophase. Difference between 1st and 2nd percentages is significant, between 1st and 3rd, not significant.
- 1030 Würgler, F.E., Ulrich, H., Schneider-Minder, A. VARIATION OF RADIOSENSITIVITY DURING MEIOSIS AND EARLY CLEAVAGE IN NEWLY LAID EGGS OF *Drosophila melanogaster*. p.101-4 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press, 1963.
- In one set of experiments eggs were irradiated (500 r of 50 keV x-rays) at different ages, having been maintained at 24.4°C from oviposition until completion of irradiation. Variations of x-ray induced embryonic mortality during meiosis and early cleavage in *Drosophila* eggs are shown in a graph. Peaks of radiosensitivity (high embryonic mortality) were obtained in late anaphase/early telophase of meiosis II of every cleavage division so far analysed. The relatively lowest radiosensitivity occurred in the pronucleus and in the interphase stages. (A very similar pattern of sensitivity has been reported by von Borstel (same symposium) for *Habrobracon*). Two groups of easily distinguishable lethal syndromes are (1) early death = death before gastrulation, and (2) late death = death after gastrulation but before hatching of larvae. Dose-action curves were recorded at every stage during the first 1/2 h of development. The curve for early death has an initial slope followed by a flattening off and a further increase at higher doses. In exactly the same region in which the flattening off was found the late death curve shows a steep increase. Total embryonic mortality (the sum of the 2 curves) is therefore the superposition of dose-action curves for different syndromes of lethality. Interpretation of the early-death curves is attempted.
- See also:
- 757 Dependence of the frequency of occurrence of dominant lethal mutations in the spermatids of *Drosophila* upon dose of irradiation with fast neutrons. (Abeleva and Lapkin, 1963)
- 758 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1959)
- 759-60 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1960, 1961)
- 764 Effects of x-rays on female germ-cells of *Drosophila melanogaster*. I. Dominant lethal mutation and oviposition in relation to treated stage. (Bateman and Chandley, 1963)
- 770 The induction of mutations in spermatocytes of *Drosophila melanogaster* with x-rays. (Chandley, 1962)
- 771 Developmental-genetic study of the effect of x-ray irradiation in *Drosophila virilis* and *Bufo variegatus*. (Clayton, 1961)
- 785 The response of *Drosophila* testis to x-ray induction of dominant lethals. (Hoenigsberg et al., 1961)
- 800 Induction of mutations and cell killing in irradiated *Drosophila* spermatogonia. (Ofstedal, 1963)
- 802 Induction of mutations and killing of cells in irradiated spermatogonia of *Drosophila*. (Ofstedal, 1963)
- 814 Studies on the genetic effect of radiation 1959-1960. II. Studies on the genetic effect of radiation with silkworm. (1) Differences between times of death of the F_1 after irradiation of oögonia or mature oöcytes. (Tazima and Onimaru, 1962)
- 816 X-ray induced "dominant lethals" in inseminated eggs of *Drosophila*. (a) Experiments in the stage between completion of meiosis and beginning of cleavage. (Ulrich, 1963)
- 820 X-ray induced "dominant lethals" in inseminated eggs of *Drosophila*. (b) Experiments with different stages between insemination and end of second cleavage division. (Würgler, 1963)
- 826 The relatively high frequency of whole-body mutations compared with fractionals induced by X-rays in *Drosophila* sperm. (Altenburg and Browning, 1961)
- 838 X-ray induced sex-linked recessive lethals and visibles in *Sciara* (i.e. *Bradystia*) *coprophila*. (Crouse, 1961)
- 851 Structure of "yellow" mutations induced by x-rays of scute⁴ chromosomes of different germ cells in *Drosophila melanogaster*. (Frye, 1961)

- 859 The effect of small doses of ionizing radiation on the frequency of occurrence of sex-linked, recessive, lethal mutations of Drosophila. (Giembotukil et al., 1963)
- 888 The rates of visible mutations in sequential broods of irradiated Drosophila melanogaster males. (Hannah-Alava, 1963)
- 869 Embryonic lethals induced by x-irradiation of first meiotic metaphase oocytes of Habrobracon. (Heidenthal, 1962)
- 912 X-ray induced visible mutations in Habrobracon oocytes. (Whiting, 1963)
- 918 Chromosome rearrangements induced by x-rays in immature germ cells of Drosophila. (Abrahamson, 1961)
- 961 Analysis of irradiated Drosophila populations for meiotic drive. (Novitski and Hanks, 1961)
- 970 Induction of chromosome aberrations in the spermatocytes of grasshopper. (Ray-Chaudhuri, 1961)
- 972 The relationship between type of aberration and sensitivity pattern in irradiated Drosophila melanogaster males. (Sävthagen, 1961)
- 1033 Chemical effects on x-ray induced mutation processes in Drosophila. (Sobels, 1961)
- 1034 Dependence of the frequency of occurrence of recessive sex-linked lethal mutations in Drosophila spermatogenesis on the fast-neutron dose. (Abeleva, and Lapkin, 1963)
- 1035 Further studies on the influence of oxygen on x-ray-induced rearrangement in Drosophila oocytes. (Abrahamson, 1961/62)
- 1036 The relationship of radiations and environmental changes in oxygen concentration for biological damage in the immature germ cells of Drosophila virilis. (Alexander, 1958)
- 1037 The effects of radiation on the genetic system of organisms in relation to their physiological and biochemical systems. (Alexander, 1958)
- 1040 The response of pre-meiotic and post-meiotic germ cells of Drosophila to dose fractionation and changes in partial pressures of gases. (Alexander, 1962)
- 1041 Oxygen effects and dose fractionation in the developing germ cells of Drosophila virilis. (Alexander, 1963)
- 1054 The effects of chloramphenicol, streptomycin and penicillin on the induction of mutations by x-rays in Drosophila melanogaster. (Clark, 1963)
- 1065 The oxygen effect in irradiated mature and meiotic germ cells of Drosophila melanogaster. (Hoenigsberg et al., 1961)
- 1074 Post-irradiative effects of nitrogen and carbon monoxide on hatchability of Habrobracon eggs treated in first meiotic metaphase. (LaChance, 1961/62)
- 1081 Effects of radiations on cell division and chromosomes in animals. Final Report No.2, 15 Dec. 1961-14 Dec. 1962. (Makino, 1962)
- 1087 Differential yields of mutations from the first and second marings after irradiation of mature sperm in Drosophila melanogaster. (Mossige, 1963)
- 1100 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)
- 1107 The effect of x-ray treatment combined with air, nitrogen, or oxygen in Drosophila melanogaster studied on sex-linked recessive lethals. (Pozzi et al., 1962)
- 1108 Differential sensitivity of spermatogenic stages of Drosophila melanogaster to x-ray irradiation in O_2 and N_2 . (Pozzi et al., 1962)
- 1110 Dose-rate and the induction of mutation in Drosophila. (Purdum and McSheehy, 1963)
- 1112 The effect of intensity and fractionation on radiation-induced mutation in Drosophila. (Purdum, 1963)
- 1113 Protective action of Versene against radiation damage to grasshopper chromosomes. (Ray-Chaudhuri and Saha, 1960)
- 1114 Cysteamine protection of grasshopper chromosomes from x-ray-induced aberrations under aerobic and anaerobic conditions. (Ray-Chaudhuri et al., 1962)
- 1115 The genetical response of radiation spermatozoa to different types of radiation treatment. (Reddi, 1963)
- 1121 The frequency of XO males and induced autosomal crossovers after irradiation of Drosophila melanogaster males in air or commercial nitrogen. (Sävthagen, 1961)
- 1123 The effect of carbon monoxide as a respiratory inhibitor on the production of dominant lethal mutations by x-rays in Drosophila. (Schmid, 1961)
- 1127 Recovery from premutational damage of x-irradiation in Drosophila spermatogenesis. (Sobels and Bates, 1961)
- 1128 The role of oxygen in radiosensitization by cyanide in Drosophila. (Sobels, 1961)
- 1129 Modifications of the mutagenic effect of x-irradiation in Drosophila males by chloramphenicol and ribonuclease. (Sobels, 1962)

- 1130 Dose rate, cyanide, and some other factors influencing repair of mutational radiation damage in Drosophila. (Sobels, 1962)
- 1131 Modification of pre-mutational radiation damage in Drosophila. (Sobels, 1962)
- 1138 Experiments on repair of pre-mutational radiation damage in Drosophila. (Sobels, and Tate, 1963)
- 1134 The contrasting effects of oxygen and nitrogen in determining initial sensitivity and postirradiation recovery in Drosophila sperm and spermatids. (Sobels, 1963)
- 1136 Repair and differential radiosensitivity in developing germ cells of Drosophila males. (Sobels, 1963)
- 1141 Modification of genetic radiation damage in Drosophila by post-treatment with nitrogen and fractionation of the dose. (Tate and Sobels, 1961)
- 1150 Dose-dependence of radiation-induced mutation rate in Drosophila melanogaster depending on the stage sensitivity of the irradiated germ cells. (Traut, 1962)
- 1151 A study of dose-dependence of radiation-induced mutation rates in Drosophila melanogaster, allowing for the degree of maturity of the germ cells. (Traut, 1962)
- 1152 Dose dependence of the frequency of radiation induced recessive sex-linked lethals in Drosophila melanogaster. (Traut, 1963)
- 1153 Dose-dependence of the frequency of radiation-induced recessive sex-linked lethals in Drosophila melanogaster, with special consideration of the stage sensitivity of the irradiated germ cells.
- 1161 Temperature effects on lethal mutation rates of Habrobracon oöcytes x-irradiated in first meiotic metaphase.
- 1163 The effect of roentgen rays and of high temperature upon the crossing over process. (Zakharov and Inge-Vechtomov, 1963)
- 1162 The influence of oxygen on the frequency of radiation-induced chromosome aberrations in oöcytes of Drosophila melanogaster. (Wind and Traut, 1961)
- 1165 Cell killing and the problem of nuclear reactivation. (Borstel and Löffbecke, 1962)
- 1173 Cytogenetic investigations on the nature of dominant lethals induced in meiotic oöcytes by gamma radiation and alkylating agents. (LaChance and Riemann, 1963)
- 1175 Mutational response of Habrobracon oöcytes in metaphase and prophase to ethyl methanesulfonate and nitrogen mustard. (Löffbecke and Borstel, 1962)
- 1189 Cytological evaluation of differential radiosensitivity in spermatogenous cells of Drosophila. (Kaufmann and Gay, 1963)
- 1190 Radiation effects on the cytoplasm of Habrobracon eggs. (Kenworthy, 1962)
- 1194 A quantitative study of chromosomal elasticity and its influence on chromosome movement. (Nicklas, 1963)
- 1195 Studies on the normal and x-irradiated spermatogenesis of Stenobothrus viridulus and Schistocerca gregaria (Orthoptera). (Mathur, 1960)
- 1196 The effect of x-radiation on the spermatogenesis of Petrobius maritimus. (Mathur, 1961)
- 1197 Cytochemistry of the normal and x-irradiated spermatogenesis of Stenobothrus viridulus (Fischer). (Mathur, 1963)
- 1200 The influence of x-rays on organelle induction and differentiation in grasshopper spermatogenesis. (Tahmisián and Devine, 1961)
- 1201 Cytological effects. (Tahmisián, 1961)
- 1222 Effects of radiations on insects. (LaChance, 1962)
- 1264 Radiosensitivity of developing reproductive cells in female Cochliomyia hominivorax. (LaChance and Leverich, 1962)
- 1287 Fecundity studies on x-rayed Mormoniella vitripennis. (Ray, 1963)
- 1290 Investigations on the spermatogenesis and embryonic development following irradiation of Calliphora erythrocephala Meig., Diptera, Calliph., males. (Taage, 1963)

I-A-6 MODIFYING FACTORS
(INTENSITY. PLOIDY. RBE. LET. TEMPERATURE. SYNERGISTS.
CHEMICALS INCLUDING PROTECTIVE AGENTS.
ENVIRONMENT AT IRRADIATION. Etc.)

General

- 1031 Clark, A.M. MODIFICATION OF GENETIC RESPONSE TO X-IRRADIATION IN Drosophila. p.216-28 In "Radiobiology. Proceedings of 3rd Australasian Conference on Radiobiology, Sydney, 15-18 August 1960". Ibery, P.L.T., Ed., London, Butterworths. 1961.

Modification may be achieved by varying the physical conditions of irradiation (nature of radiation, dose and dose rate, temperature), by altering the chemical conditions (varying degrees of anaerobiosis, the use of metabolic inhibitors before, during or after irradiation) or by changing the physiological state of the material irradiated. The main topic considered in the review is whether, in *Drosophila* spermatozoa, modification in genetic response to x-irradiation may be obtained by varying the dose rate. The evident complexity of factors which must be taken into account in interpreting data is discussed. Relevant findings published variously between 1954 and 1960 are reviewed critically.

- 1032 Herskowitz, I.H. AN INFLUENCE OF MATERNAL NUTRITION UPON THE GROSS CHROMOSOMAL MUTATION FREQUENCY RECOVERED FROM X-RAYED SPERM OF *Drosophila melanogaster*. *Genetics* **48**, 5 (1963) 703-10.

Undemourishment of females before, or before and after they were mated and x-rayed with about 3500 r significantly increased the rate of 2-3 reciprocal translocations recovered from the irradiated sperm chromosomes, as compared with the rate recovered from continuously well fed, otherwise comparable females. The rate of such paternal mutations increased (as much as 50%) in eggs successively oviposited by females that were undernourished before they were mated and irradiated. The rate of complete or certain partial losses of a paternal sex chromosome (rod Y or rod X, or ring X or rod X) increased about 300 to 600% in eggs successfully oviposited by females which were undernourished before and after they were mated and x-rayed with about 3500 r. It is hypothesized that mutational enhancement by undernourishment is associated with some effect upon the joining of chromosome ends produced by breakage. (From auth. summary)

- 1033 Sobels, F.H. CHEMISCHE BEZINFLUSSUNG DES RÖNTGENINDUZIERTEN MUTATIONSPROZESSES BEI *Drosophila*. (Chemical effects on x-ray induced mutation processes in *Drosophila*.) *Naturwissenschaften* **48**, 6 (1961) 146-55. (In German)

A review, with 53 references. Pre-treatment with cyanide, formaldehyde or dihydroxydimethylperoxide was found to increase the x-ray induced mutation rate, more markedly in spermatids than in mature spermatozoa. The cyanide effect is probably due to an increase in O_2 . Post-treatment with cyanide increased the mutation rate in spermatids provided they had been exposed to a high dose rate, whether in O_2 or in N_2 atmospheres. Increased translocation rates in spermatids occurred independently of the dose rate. Cyanide post-treatment increased the rate of lethal mutations even when a ring chromosome had been treated. Possible interpretations are discussed.

- 1034 Абелева, Э.А., Лапкин, Ю.А. ЗАВИСИМОСТЬ ОТ ДОЗЫ БЫСТРЫХ НЕЙТРОНОВ ЧАСТОТЫ ВОЗНИКНОВЕНИЯ РЕЦЕССИВНЫХ СЩЕПЛЕННЫХ С ПОЛОМ ЛЕТАЛЬНЫХ МУТАЦИЙ В СПЕРМИОГЕНЕЗЕ ДРОЗОФИЛЫ. *Радиобиология* **3**, 3 (1963) 420-1.

Abeleva, E.A., Lapkin, Yu.A. DEPENDENCE OF THE FREQUENCY OF OCCURRENCE OF RECESSIVE SEX-LINKED LETHAL MUTATIONS IN *Drosophila* SPERMATOGENESIS ON THE FAST-NEUTRON DOSE. *Radiobiologiya* **3**, 3 (1963) 420-1.

Experiments carried out to clarify the fast-neutron-dose dependence of the occurrence frequency of dominant lethal mutations were inconclusive. The difference between the frequencies in spermatids and sperm with neutron irradiation was less than in γ - and x-irradiation. The dependence on dose in the range 1200-2400 rad tapered off, as in γ -irradiation, but the absolute frequency was so high that it was explained by the reaching of the limits of possible occurrence of the given type of mutation. To determine if hidden factors are involved or if the nature of the mutations caused by fast neutrons in spermatids is similar to that in low-ionizing radiation, the recessive sex-linked lethal mutations were studied, which are less frequent than the dominant. Comparison of the data obtained with earlier data showed that the ratios between the frequencies of mutation in spermatids and sperm in neutron-irradiation at 1000 rad are the same for 1000-r γ -radiation, that is, 2.27 and 2.16, respectively. In the 1000- to 2000-r range the frequency of mutation occurrence was proportional to the 0.57 power of the dose with γ -irradiation and to the 0.37 power with neutron irradiation. (NSA 17:1963, 31936)

- 1035 Abrahamson, S. FURTHER STUDIES ON THE INFLUENCE OF OXYGEN ON X-RAY-INDUCED REARRANGEMENT IN *Drosophila* OOCYTES. *Int. J. Rad. Biol.* **4**, 2 (1961/62) 113-25.

Alteration of the metabolism of *Drosophila* oocytes greatly affects the induction of structural changes by x-rays. Females 2-3 d of age contain oocytes whose chromosomes restitute and rearrange rapidly, whereas no evidence for restitution within the intervals studied was found in samples of oocytes from females

8-9 d old at the time of irradiation. The effect of nitrogen as a post- or inter-treatment showed, however, that for both young and old oocytes there was more restitution in air than in nitrogen. Both young and old oocytes show reduced rearrangement frequencies when irradiations were performed in nitrogen, and increased rearrangement frequencies when a fractionated irradiation was performed with the flies maintained in a N_2 environment between irradiations. These different effects of anoxia are discussed. (Auth.)

- 1036* Alexander, M.L. THE RELATIONSHIP OF RADIATIONS AND ENVIRONMENTAL CHANGES IN OXYGEN CONCENTRATION FOR BIOLOGICAL DAMAGE IN THE IMMATURE GERM CELLS OF Drosophila virilis. p.3-4 in "Proceedings of 10th International Congress of Genetics, McGill University, Montreal, 20-27 August 1958. Vol.II", Toronto, University of Toronto Press, 1958.

Lethal damage in meiotic and spermatogonial cells was found to be influenced by increased O_2 concentrations with both x-ray and fast neutrons. Differences in lethal damage induced in spermatids by γ -rays in pure oxygen were obtained by varying radiation dose rates. Biological damage induced by x- and γ -rays and fast neutrons was consistently higher in spermatids than in mature sperm when O_2 was present at the time of treatment. A slight but definite enhancement was also obtained with oxygen with fast neutrons in various types of immature germ cells. (NSA 16:1962, 23470)

- 1037* Alexander, M.L. THE EFFECTS OF RADIATION ON THE GENETIC SYSTEM OF ORGANISMS IN RELATION TO THEIR PHYSIOLOGICAL AND BIOCHEMICAL SYSTEMS. Progress Report, May 1, 1957 - April 30, 1958. TID-17000, Texas, Univ., Houston, M.D. Anderson Hospital and Tumor Inst. 17p.

The effects of radiation on the genetic system of organisms in relation to their physiological and biochemical systems were investigated in the immature germ cells of Drosophila virilis. This biological system offers a group of cells composed of spermatogonial cells, meiotic cells, and post-meiotic spermatid and sperm cells. Different amounts and types of biological damage were observed in the different types of cells. Results are presented on the effects of fast neutrons, 200 kV x-rays, 1.17- to 1.33 MeV γ -rays from a Co^{60} source, and 22-MeV x-rays from a betatron source. The RBE values for the radiations used were calculated using the rad dose necessary to produce lethals in 50 % of cells. Data are tabulated. (NSA 16:1962, 1236)

- 1038 Alexander, M.L., Bergendahl, J. BIOLOGICAL DAMAGE IN THE MATURE SPERM OF Drosophila virilis IN OXYGEN AND NITROGEN WITH DIFFERENT DOSE INTENSITIES OF GAMMA RAYS. Genetics 47 (1962) 71-84.

Modifications in the percentages of dominant lethal and translocation damage were not obtained by varying the dose rate of γ -rays in treatments of mature sperm of D. virilis. Nineteen experiments in 5 series of tests were performed using radiation dose rates from 50 r/min to 2000 r/min or 2 fractionated doses divided by periods from 15 to 60 min. The dose rates of γ -rays did not modify the amount of 2 break, reattachment types of chromosome damage, translocations, or dominant lethal damage when treatments were made in either a completely oxygen-saturated atmosphere or an anoxic atmosphere of N_2 . Post-irradiation recovery periods were not detected by testing with alternate radiation treatments in O_2 and N_2 . Different time intervals of 15 to 40 min between treatments failed to produce modifications in the percentages of dominant lethals. Therefore, there is no indication of a post-irradiation time limit for recovery mechanisms in Drosophila sperm. The possibility of genetic "repair" mechanisms operating after chronic irradiation of spermatogonial cells and of post-irradiation effects in metabolically active cells are discussed briefly. (From auth. summary)

- 1039 Bicker, A.E. RELATIVE EFFECTIVENESS OF 14 MeV NEUTRONS AND 200 kVp X-RAYS FOR PRODUCTION OF LETHALITY IN GRASSHOPPER EMBRYOS. A preliminary study. Thesis. TID-15962, Kansas. Univ., Lawrence. May 1962, 52p.

A test system using the grasshopper embryo (Chortophaga viridifasciata (deGeer), and Encoptolophus sordidus (Burmeister)) with hatching as the criterion for the end point is proposed to determine the RBE. Eggs of Chortophaga (14-d) and Encoptolophus (14-d and terminal) were subjected to various doses of 200 kVp x-rays, and eggs of Chortophaga to various doses of neutrons. X-ray median lethal doses were estimated (650 rads for Chortophaga (14-d), 760 rads and 1800 rads for Encoptolophus, 14-d and terminal, respectively). In view of the lack of data in the region of decreasing survival of Chortophaga (14-d) embryos subjected to neutron irradiation, the shape of the dose-effect curve relative to x-irradiation survival was assumed to be unchanged so that an LD_{50} estimate of 370 rads was obtained. The RBE of 14 MeV neutrons and 200 kVp x-rays on Chortophaga (14-d) embryos was 1.76 (obtained from the LD_{50} ratio).

- 1040 Alexander, M.L. THE RESPONSE OF PRE-MEIOTIC AND POST-MEIOTIC GERM CELLS OF *Drosophila* TO DOSE FRACTIONATION AND CHANGES IN PARTIAL PRESSURES OF GASES. (Abstr.) p.186 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The relationships of oxygen concentrations and the distribution of x-ray dose were tested by modification of the frequencies of sex-linked recessive lethals, translocations and dominant lethals induced in the germ cell cycle of *Drosophila*. X-ray treatments were given young males of *D. melanogaster* held under pressures of 2 atm O_2 plus 3 atm argon gas. In comparative tests, the intracellular oxygen concentration was limited by using 4.3 atm argon. An x-ray dose of 2000 r was given at 25°C at a continuous rate in 2-min periods, or fractionated into two equal doses 40 min apart at a fast rate. X-ray-treated males were remated every 2 d for 2 weeks. In post-meiotic sperm and spermatid germ cells, fast and fractionated doses gave similar results for all three types of genetic damage with the oxygen-argon mixture. When oxygen was limited with treatment under 4.3 atm argon, higher percentages of recessive lethals and translocations were observed in spermatid cells with fractionated than with fast doses. Dominant lethals were not modified in post-meiotic cells with fast or fractionated doses in either gas environment. In spermatogonial cells, dominant lethals were increased by fractionating the dose in both argon and oxygen+argon. The germ cell cycle of *D. virilis* was tested for protecting actions of the inert gases, helium and argon. Dominant lethal damage was tested in 1 atm air, 1 atm air + 9 atm helium, and 1 atm air + 9 atm argon. Neither inert gas, at 9 atm pressure, suppressed lethal damage below the air test.

- 1041 Alexander, M.L. OXYGEN EFFECTS AND DOSE FRACTIONATION IN THE DEVELOPING GERM CELLS OF *Drosophila virilis*. (Abstr. 5.45) p.70-1 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

1-d-old males of *D. virilis* were treated with 1000 r of x-rays while under 74.7 lb pressure of argon gas and in a gaseous atmosphere of 45 lb argon + 19.7 lb O_2 . X-rays were given at a rate of 1000 r/min as a single dose and as two doses fractionated by a period of 40 min. Additional tests were made with 2000 r under 64.7 lb of argon. Postmeiotic, meiotic and premeiotic germ cells were tested for induced biological damage. Dominant lethals in postmeiotic sperm and spermatid cells were increased by the presence of oxygen. In sperm and spermatids, there were no differences in the percentages of dominant lethals or translocations with dose rate changes in argon or when O_2 was present. These results differed from those observed for *D. melanogaster* where dose fractionation in argon, but not oxygen, increased translocations, sex-linked lethals and dominant lethals in spermatids. The premeiotic cells of *virilis*, as *melanogaster*, showed an enhancement in dominant lethals with dose fractionation in both anoxic and oxygenated gases. Enhancement with dose fractionation in *virilis* appears to be limited to later spermatogonial stages. The stem cells do not respond to dose fractionation. Enhancement of lethals in premeiotic cells has been observed in anoxic and oxygenated atmospheres of gases in both species. Differences in response of spermatid cells in *virilis* and *melanogaster* may be due to oxygen metabolism or other metabolic differences in the two species. Spermatogenic cysts are not prevalent in young males of either species and the differences cannot be explained by mixed populations of resistant and sensitive spermatid cells.

- 1042 Alexander, M.L., Bergendahl, J. RADIATION SENSITIVITY IN SPERM TREATED IN MALES AND INSEMINATED FEMALES OF *Drosophila* WITH X-RAYS IN NITROGEN AND AIR. (Abstr. E1) *Rad. Res.* 16 (1962) 572.

Mature sperm were treated with 4000 r of x-irradiation, simultaneously, in mature males and inseminated females of *D. melanogaster*. One treatment was in air and the other in nitrogen. Translocations and sex-linked recessive lethals were tested the 1st and 2nd day after treatment. In air, the results for inseminated females were 9.37% (3/32) the 1st day and 10.72% (43/401) the 2nd day for sex-linked lethals; for translocations, 18.05% (39/216) and 17.29% (82/474) were observed for the 1st and 2nd days. For sperm treated in males (air), the results were 9.68% (109/1128) and 7.00% (57/814) sex-linked lethals and 9.35% (52/558) and 7.51% (42/559) translocations the 1st and 2nd days. In N_2 , the results for inseminated females were 4.78% (7/147) and 8.19% (82/757) for sex-linked lethals the 1st and 2nd days. For translocations, 4.87% (20/411) and 8.03% (55/685) were observed the 1st and 2nd days. Mature males gave results of 5.83% (78/1338) and 5.26% (66/1255) for sex-linked lethals and 3.95% (22/557) and 3.85% (21/546) translocations the 1st and 2nd days. In both gases, totals for both days show higher translocation and sex-linked lethal percentages induced in sperm in inseminated females than in males. High translocation values indicate that chromosome breakage is an important factor for increased sensitivity. Genetic damage was not reduced consistently the 2nd day after treatment to indicate that recovery mechanisms act in males. The data indicate that postirradiation enhancement in air may result the second day after treatment in N_2 in inseminated females.

- 1043 Amer, N.M. MODIFICATION EFFECTS WITH MAGNETIC FIELDS. p.55-8 in "Biology and Medicine. Semiannual Report, Spring 1963". UCRL-11033, California. Univ., Berkeley. Donner Lab. and California. Univ., Berkeley. Donner Pavilion.
- A modifying effect of a constant magnetic field on the course of wing development was demonstrated in Tribolium confusum irradiated as pupae using 1200 r of 250-kVp x-rays at rate of 1000 r/min. The effects of temperature are discussed. (NSA 18:1964, 5006)
- 1044 Amherst Coll., Mass. GENETIC AND DIRECT EFFECTS OF γ RADIATION ON Drosophila. Progress Report 1962. TID-19003. 10p.
- Progress is reported in studies of the mutagenic effects of different dosage levels of γ rays during various stages of spermatogenesis in Drosophila melanogaster under controlled, varied genetic and environmental conditions. Data are presented on the dosage-mutation rate pattern during spermatogenesis, the relation between developmental temperature and mutational response to γ irradiation, and the organization of genetic material on chromosomes. An analysis was made of a natural population of D. melanogaster. A list is included of publications during the period. (NSA 17:1963, 28683)
- 1045 Baumhover, A.H. INFLUENCE OF AERATION DURING GAMMA IRRADIATION OF SCREW-WORM PUPAE. J. econ. Ent. 56, 5 (1963) 628-31.
- Screw-worms (Cochliomyia hirsutivora (Coquerel)) have shown variable response to the standard dose level of γ -rays from Co^{60} -sources used in routine production of sterile flies. The primary influence was found to be availability of O_2 during irradiation. When pupae were irradiated in a CO_2 atmosphere, a dosage of 11 000 r was required to sterilize the females, compared with only 5500 r to 6200 r required in O_2 and air (forced ventilation). Anoxia induced by consumption of O_2 by the pupae produced radiation-protection effects that were intensified by delay prior to irradiation and/or increased rate of O_2 uptake as pupae advanced in age. In practical tests, a canister made of 1/8-inch mesh Al screen provided sufficient diffusion of air to standardize the dosage safely at 6900 r, with up to 30 min delay prior to treatment for pupae 5 d of age or older. This dosage reduces by 50% that required under maximum conditions of anoxia encountered in production when a closed canister is used. (Auth.)
- 1046 Biellmann, G. EFFETS D'IRRADIATIONS LOCALISÉES CHEZ Locusta migratoria L. Bull. Soc. Zool. France 86, 1 (1961) 99-106.
- 1047 Burdette, W.J. INFLUENCE OF PENICILLIN ON FREQUENCY OF INDUCED MUTATION. Proc. nat. Acad. Sci., Wash. 47 (1961) 1813-7.
- The frequency of lethal mutations induced in the X chromosome of Drosophila by x-irradiation (3000 r at 500 r/min) is diminished to 1/3-1/2 by administration of penicillin in concentrations above a threshold value (20 000 u/ml). The diminution in percentage of mutations occurs in all stages of spermatogenesis tested. Enhancement of mutation frequency by O_2 is curtailed by administering penicillin both in the stages of gametogenesis with greatest frequency of lethals and when all stages are combined. The number of heritable tumours in the susceptible strain of Drosophila used are also reduced both by penicillin and irradiation.
- 1048 Burdette, W.J. ALTERATION OF MUTATION FREQUENCY BY TREATMENT WITH ACTINOMYCIN D. Science 133 (1961) 40.
- The frequency of lethal mutations occurring in Drosophila melanogaster was reduced by approximately 1/2 when (x-) irradiated males were treated with actinomycin D, which also inhibited the appearance of melanotic atypical growths in the strain used for the study. (Auth.)
- 1049 Capps, A.S. THE EFFECTS OF NITRIC OXIDE ON RADIATION DAMAGE IN Drosophila virilis AND Drosophila melanogaster. Genetics 46, 2 (1961) 123-7.
- Nitric oxide present during irradiation at a concentration of 3% in He enhanced genetic damage resulting from 1000 r of x-rays. Damage was measured by the production of dominant lethals in D. virilis and sex-linked recessive lethals in D. melanogaster. Under similar conditions 3% O_2 in He showed no effect on the production of dominant lethals by x-rays. Nitric oxide had the additional effect, independent of irradiation, of delaying development of germ cells in D. virilis. (Auth.)

- 1050 Carfagna, M., De Capoa, A., Duraccio, F. EFFECTS OF A PROLONGED EXPOSURE OF ARTIFICIAL POPULATIONS OF Drosophila melanogaster TO $MnCl_2$. Genet. agr. 16, 1/4 (1963) 354-64. (In Italian).
Populations of D. melanogaster were exposed to 0.2-0.6% $MnCl_2$ and simultaneously to x-rays (500 r/generation). Fertility was significantly decreased after 20 generations of $MnCl_2$ exposure. (CA 61:1964, 4762 b)
- 1051* Chang, T.H., Wilson, F.D., Stone, W.S. GENETIC RADIATION DAMAGE REVERSAL BY NITROGEN, METHANE, AND ARGON. Proc. nat. Acad. Sci. 45 (1959) 1397-1404.
- 1052* Chang, T.H. REDUCTION OF THE SEX-LINKED RECESSIVE LETHAL FREQUENCIES IN Drosophila melanogaster BY ARGON, NITROGEN, AND METHANE UNDER PRESSURE. Dissertation. The University of Texas. 1960.
(Note: An assumption made here that x-rays would produce more lethals in 10 atmospheres of O_2 than in 1 atmosphere has since been proved untenable.)
- 1053 Chang, T.H. FURTHER OBSERVATIONS ON THE RELATION BETWEEN GAS PRESSURE AND THE X-RAY DAMAGE IN Drosophila melanogaster. p.385-83 in "Studies in Genetics. II. Research Reports on Drosophila Genetics, Taxonomy and Evolution". Wheeler, M.R., Ed. Austin, The University of Texas. 1962.
Increase in air pressure increases the x-ray damage measured as sex-linked and dominant lethals. An increase in pressure of pure O_2 , on the other hand, does not. The same is true for argon and N_2 . Whereas 8 atmospheres (atm) of argon were not able to counteract the effect of 2 atm of O_2 , 9 atm of argon definitely reduces the effect of 1 atm of O_2 almost to the anoxic level. The typical differential response of spermatogenic cells to x-rays was observed: early spermatids are most sensitive to recessive, spermatocytes to dominant lethal induction. This differential response is much less obvious when the flies are treated in anoxia. The high radiosensitivity of spermatids (and spermatocytes) is therefore at least partially attributable to the presence of O_2 . Treatment of flies in gases and mixtures without radiation has no effect.
- 1054 Clark, A.M. THE EFFECTS OF CHLORAMPHENICOL, STREPTOMYCIN AND PENICILLIN ON THE INDUCTION OF MUTATIONS BY X-RAYS IN Drosophila melanogaster. Z. Vererb Lehre 94, 2 (1963) 121-5.
Injection of chloramphenicol, streptomycin or penicillin into Drosophila males just before exposure to (1000 r) x-irradiation causes a reduction in the yield of sex-linked recessive lethal mutations. The effect appears to be primarily on spermatids and possibly spermatocytes. In the absence of x-irradiation, the injections of these antibiotics are certainly not markedly mutagenic in Drosophila.
- 1055 Clark, A.M., Cristofalo, V.J. SOME EFFECTS OF OXYGEN ON THE INSECT Anagasta künniella AND Tenebrio molitor. Physiol. Zool. 34 (1961) 55-61.
The larvae and pupae of A. künniella and T. molitor were exposed for 5 min to O_2 at pressures of 15-75 lb/in² and the effects were compared with controls maintained in O_2 and air at 15 lb/in². Under such conditions A. künniella pupae were injured and showed decreased O_2 consumption. Larvae, although sensitive to O_2 , were more resistant than pupae. Unpigmented T. molitor pupae were injured after exposure to 60 and 120 lb/in² O_2 which affected their ability to become pigmented and to consume O_2 . A 5000-r dose of x-rays arrested development of T. molitor larvae, whereas 50 000 r were required to arrest development of pupae, although the O_2 consumption of the latter was not decreased after such exposure. (CA 55:1961, 11687 b)
- 1056 Dubinin, N.P., Grozdova, T.Ya. STREPTOMYCIN, RADIATION, AND NATURAL MUTABILITY. Dokl. Akad. Nauk SSSR, 148 (1963) 1397-9.
Experiments with Drosophila showed that the antimutagenic effect of streptomycin, administered by intra-abdominal injection, affects not only the chromosome rearrangements but also the spot (and gene) mutations. The effect was observed both in the development of sperm characterized by high natural mutability and in the development of the egg cells. No protective action by this drug was found among embryo cells which were irradiated with x-rays at 3000 r dosage. The mutagenic effect of streptomycin was not observed in these tests. Administration of streptomycin lowered the natural mutability of males, caused by metabolic peculiarities in the early pupal stage. This result indicated that either potential

changes in chromosomes exist in case of natural mutagenesis or that mutagenic agents exert their action on the sperm only after a certain period after administration. (CA 58:1968, 14434f)

- 1057* Ellis, J.F., Harris, T.M., Osheimer, J.T., Plough, H.H. THE EFFECTS OF COMBINED GAMMA RADIATION AND ETHER TREATMENT ON THE FREQUENCY OF EGG LETHAL IN Drosophila melanogaster. Rec. Genet. Soc. Amer. 26 (1957) 368.
- 1058 Falk, R. NITROGEN-TREATMENT EFFECTS ON REARRANGEMENT-INDUCTION PATTERNS IN Drosophila melanogaster. Int. J. Rad. Biol. 4, 5 (1961/2) 437-55. (In English)
- Recovered rates of Y-chromosome-autosomal translocations (Y-A) induced in spermatids of pupae of D. melanogaster, as well as the chromosomes 2-3 translocations (2-3), were higher in crosses to females having an attached X.Y-chromosome than to regular females. This suggests that numerous position-effect sterility mutations were induced in the Y-chromosomes as well as in the autosomes. N_2 -treatment after irradiation of 800 r did not increase the frequencies of translocations recovered. Prolonged N_2 pre-treatment apparently retarded development so that irradiation involved an earlier and more sensitive stage of spermiogenesis than without pre-treatment. When two irradiations were given 14 h apart in air, breaks induced in the 1st irradiation rejoined prior to the 2nd. The change in the frequency of X-chromosome recessive lethals over the 14 h separating the two irradiations applied to the spermatids is much larger than that of breaks involved in translocations. At least some recessive lethals are apparently caused by intra-genic mutations as opposed to inter-genic breaks.
- 1059 Fritz-Niggli, H. BEEINFLUSSUNG DER STRAHLENINDUZIERTEN MUTABILITÄT DURCH 2,4-DINITRO-PHENOL BEI Drosophila. (Modification of the radio-induced mutability in Drosophila by 2,4-dinitrophenol.) Naturwissenschaften 48 (1961) 650-1. (In German).
- The variability of the radio-induced mutation rate with the age or development state of the germs cells can be used as an indication of a dependence of the mutation genesis on the intracellular metabolism of the cells. Therefore the effect of 2,4-dinitrophenol on the mutation rate of D. melanogaster was investigated. The results established that treatment with this chemical before irradiation diminished drastically (approximately fourfold) the number of radio-induced recessive lethal factors and chromosome losses by rupture. (NSA 16:1962, 6360).
- 1060 Giavelli, S., Callucci, E., Pozzi, L.V., Sironi, G.P. PRELIMINARY RESULTS OF COMBINED EFFECTS OF OXYGEN AND LOW TEMPERATURES ON MUTATIONS INDUCED BY X-RAYS IN Drosophila. Atti Ass. genet. ital. 8 (1963) 194-204. (In Italian).
- In order to study the mechanism of the oxygen effect in x-ray-induced mutations, D. melanogaster Oregon-R males were irradiated in oxygen at 25°C and 0°C., thus at normal and low metabolism. Sex-linked x-ray-induced recessive lethals were scored, and no difference was found in the mutation frequency induced by the two treatments at different temperature. The oxygen effect was considered independent from the metabolism of the irradiated cells. (Auth., NSA 17:1963, 28710)
- 1061* Glass, B., Mettler, L.E. THE OXYGEN EFFECT IN RESPECT TO POINT MUTATIONS IN Drosophila melanogaster. p.97-8 in "Proceedings of 10th International Congress of Genetics, McGill University, Montreal, 20-27 August 1958. Vol. II". Toronto, University of Toronto Press, 1958.
- 1062 Gliembotskij, Ya.L., Parfenov, G.P. GENETIC EFFECTS OF SPACEFLIGHT FACTORS. Probl. Kosmich. Biol. 2 (1962) 98-114.
- With the object of investigating effects of spaceflight factors on heredity, Drosophila melanogaster was carried on the 2nd, 4th, and 5th orbital spaceships and on Vostok-1 and Vostok-2. Four different space-flight effects were investigated. Non-disjunction of chromosomes was investigated by exposing unfertilized white-eyed Drosophila females on Vostoks 1 and 2 and mating them on their return with red-eyed males. Primary non-disjunction of chromosomes resulted in the appearance of 4 times as many unusual genotypes (XXY females and XO males) among the progeny of the exposed group as among offspring of the controls. However, the increase in non-disjunction cannot be ascribed to radiation effects. Induced crossovers were investigated by exposing heterozygotic males (having normal phenotypes but three recessive genes in the second chromosome) on the 5th orbital spaceship and on Vostoks 1 and 2. Upon return they were mated with homozygotic females displaying the 3 recessive characteristics (black body, cinnamon eyes, and vestigial wings). Drosophila carried in the fifth orbital spaceship with no protection against low frequency vibrations showed crossover incidence of $0.50 \pm 0.12\%$, compared to an incidence of $0.05 \pm 0.05\%$ or none

at all on Vostok spaceships, where the insect containers were cushioned against vibration. Dominant lethal mutations were investigated by exposing two strains of *D. melanogaster* (D-18 with a high rate of spontaneous lethal mutations, and D-32 with a low rate for the same mutations) of the 5 spacecraft. The number of dominant lethal mutations was found to increase somewhat in all groups exposed to space flight. Sex-linked recessive lethal mutations were investigated by exposing young males of the D-18 and D-32 strains of *D. melanogaster* on all 5 vehicles. Exposure on the 2nd and 4th orbital spaceships and on Vostok-1 resulted in statistically significant numbers of sex-linked recessive lethal mutations for spermatozoa and spermatids of both strains. However, no increase in mutations was observed following exposure on the 5th orbital spaceship and on Vostok-2. (NSA 17:1963, 21649. See also abstr. 27200)

- 1063 Guyenot, E., Kioritsis, V., Uehlinger, V. EFFECT OF FRACTIONATING DOSES ON THE RATE OF X-RAY-INDUCED MUTATIONS IN *Drosophila*. *Ann. Genet.* 4 (1961) 55-62. (In French).

The present experiment was conducted on *D. melanogaster* to determine to what extent fractionation of dose increases or decreases mutation. X-irradiation was administered in 3 ways: continuously, for 10 min; fractionated, with an interval of 9/10 min between 1/10-min exposures at an average rate of 70 r/min; fractionated, with an interval of 1/16 min. In all 3 cases the total amount of radiation was 700 r. The mutation considered was a sex-linked, lethal recessive in a wild strain of the fruit fly crossed with the Muller 5 strain. According to formulae evolved previously, the average rate of mutation was found to be 12-13% less with short intervals than with continuous irradiation, and 19% less with long intervals than with continuous irradiation. These results were obtained from 21 series of irradiations spread over 3 stages, each consisting of 2 groups. Stage A was observed 1-3 d after irradiation; stage B, 4-6 d after; and stage C, 7-8 d after. The mutation rate was concluded to be progressively reduced when the interval of protection between the fractionated x-ray doses was increased. In the case of point mutations, there is evidence for a recovery phenomenon in the various stages of male gametogenesis. (From NSA 17:1963, 38766)

- 1064 Henke, H., Höhne, G., Künkel, H.A. ÜBER DIE WIRKUNG VON AMINOÄTHYLISOTHIURONIUM (AET) AUF DIE STRAHLENINDUZIERTE MUTATIONSRATE BEI *Drosophila melanogaster*. (Study on the effect of amino-ethylisothiuroniumchloride-hydrochloride (AET) on radiation-induced mutation rate in *Drosophila melanogaster*.) *Strahlentherapie* 122, 2 (1963) 279-84. (In German)

The influence of AET on the (x-ray)-induced mutation rate of sex-linked recessive lethals was determined using the Muller-5-method. A significant increase in mutation rate was observed after the administration of AET, known as a radiation protective substance with regard to somatic damage. Chemomutagenity did not occur. The sensitizing effect was observed in sperm of different degrees of maturity.

- 1065 Hoenigsberg, H.F., Callucci, E., Giavelli, A. THE OXYGEN EFFECT IN IRRADIATED MATURE AND MEIOTIC GERM CELLS OF *Drosophila melanogaster*. *Experientia* 17, 4 (1961) 172-4.

The radiosensitivity spectrum of spermatogenesis was established for 5 doses (150, 300, 600, 1200 and 2400 r) of x-radiation applied at 200 r/min, and corresponding tests were carried out on the O_2 effect. Increased mutability was observed in the presence of O_2 , but not at all stages of spermatogenesis. A higher frequency of recessives occurred in meiosis than in mature sperm. While, at lower doses, no apparent O_2 effect was observed on mature sperm although a clear effect was observed in meiotic cells, at higher doses the O_2 effect extended to both mature sperm and meiotic stages. The most sensitive period was the one immediately following exhaustion of the mature sperm supply under the experimental conditions described. Nitrogen was observed to have a protective effect.

- 1066 Ives, P.T. THE EFFECTS OF DEVELOPMENTAL TEMPERATURE ON MUTATIONAL RESPONSE TO GAMMA RAYS IN *Drosophila* SPERMATOGENESIS. (Abstr.) *Amer. Zool.* 2 (1962) 417.

- 1067 Japan. Sericultural Experiment Station, Tokyo. STUDIES ON THE BREEDING METHOD TAKING ADVANTAGE OF γ -RAYS IN THE SILKWORM. *Nucl. Sci. Abstr.*, Japan 1 3/4 (1962) 170-1. (In English).

The effects of γ -ray treatment on the following generation with regard to hatchability, survival rate at the larval stages, pupation rate and quantitative characteristics of the cocoon are almost the same for fractional irradiation of successive generations and a single treatment of one generation, provided that the stage of the silkworm at irradiation and the total doses given are the same. Linear dose-action curves are obtained in both cases. Damage tends to be less with fractional irradiation. When one generation only is treated the lower the dose the faster generation recovery takes place for doses < 4 kr. Strains with survival rates under normal conditions are also rather resistant to γ -rays. Resistance to radiation damage of F_1 - and F_2 -hybrids is greater than that of parents, with F_1 -hybrids more resistant than F_2 -hybrids.

- 1068 Japan. National Inst. of Genetics, Mishima. STUDIES ON THE GENETIC EFFECT OF RADIATION WITH SILKWORM. Nucl. Sci. Abstr., Japan 2, 2 (1963) 72-8. (In English).
- Two types of dose rate dependence of radiation-induced mutation frequency have been found in early gonial cells of silkworm, differential repair and selective killing being suggested. Further evidence has been collected supporting the hypothesis of selective killing. Variations in induced mutation frequency were studied along with the development of germ cells, for acute and chronic irradiation. Results from cytological studies suggest that germ cells acutely irradiated at the primary and secondary spermatogonial stages must have been killed eventually, observed mutation frequency reflecting that of repopulated cells dormant at the time of irradiation while, under chronic irradiation some cells at advanced stages are able to survive a higher mutation frequency being observed.
- 1069 Japan. National Inst. of Radiological Sciences, Chiba. MUTATION RATES AT LOW LEVEL IRRADIATION IN *Drosophila melanogaster*. Nucl. Sci. Abstr., Japan 2, 2 (1963) 93-4. (In English)
- The Canton-S strain of *D. melanogaster* was used as wild type material, isogenization being performed every 4 months. Wild males were stocked for 1 week after their emergence, and irradiated with 145 r/min x rays for high doses (1000-4000 r) and 4 r/min for low doses (8-25 r). Evidence was obtained indicating that the linear relationship between mutation rates and radiation dose can apply to doses down to 8 r, sex-linked recessive lethal mutations being used as indicators. No threshold dose was observed for the genetic effects of radiation down to 8 r.
- 1070 Kostolanska, A. INFLUENCE OF POST IRRADIATION CHANGES IN THE EGGS OF *Bombyx mori* L. AT A LOWERED TEMPERATURE. Biológia, Bratisl. 17, 8 (1962) 826-8. (In Czech, with German summary)
- 1071 Krebs, J.J.F. THE EFFECT OF REPEATED X-RAY EXPOSURE UPON THE GENETIC LOAD AND MUTABILITY OF *Drosophila melanogaster*. Thesis. Saint Louis Univ. 1963. 48p.
- 1072 Künkel, H.A., Oberheuser, F. ULTRAFRACTIONATION AND BIOLOGICAL EFFICIENCY OF FAST ELECTRONS. INVESTIGATIONS ON "EGGS" OF *Drosophila melanogaster* OF DIFFERENT STAGES OF DEVELOPMENT. (Abstr.) p.6 in "2nd International Congress on Radiation, Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.
- Experiments were carried out with a 16-MeV betatron. By means of a special electronic design it was possible to quench radiation pulses in the injector of the accelerator. In this way the frequency of radiation pulses was varied between 2 and 50 cps. To compare this ultrafractionated radiation with continuous radiations, β -rays from a Sr^{90} source as well as γ -rays from a Co^{60} source were used. The influence of ultrafractionation on biological efficiency was investigated in *Drosophila* "eggs" at the "age" of 1.75, 4.5 and 6 h. Dose-effect curves were determined for each group keeping constant either the average dose rate or the dose rate of the particular radiation pulses.
- 1073 Künkel, H.A., Römer, A. EXPERIMENTS WITH CHEMICAL COMPOUNDS WHICH REDUCE OR INCREASE MUTAGENIC EFFECTS OF IONIZING RADIATIONS. (Abstr. 5.35). p.67 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963, Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.
- This paper deals with investigations on 3 chemical compounds well known as radioprotecting agents with regard to somatic radiation damage: cysteine, aminoethylisothiuronium (AET) and 5-hydroxytryptamine (serotonin). Experiments were carried out on *Drosophila* and on *E. coli*. In *Drosophila* the rate of ray-induced sex-linked recessive lethals was tested after x-irradiation by means of the Muller-5-Method. No influence of cysteine was observed in *Drosophila*. Serotonin reduced the rate of mutations in *Drosophila* as well as in *E. coli*. Protection, however, was only small. After AET the ray-induced rate of mutations significantly increased although this compound per se has no mutagenic effect. Lastly experiments are reported with bromodeoxyuridine which is incorporated into DNA instead of thymidine and provides increased radiosensitivity in some cases.
- 1074 LaChance, L.E. POST-IRRADIATIVE EFFECTS OF NITROGEN AND CARBON MONOXIDE ON HATCHABILITY OF *Habrobracon* EGGS TREATED IN FIRST MEIOTIC METAPHASE. Int. J. Rad. Biol. 4 (1961/62) 15-20.
- The effect of N_2 and of CO administered as post-radiation treatments (x-rays) was investigated. The hatchability of *Habrobracon* eggs treated in first meiotic metaphase was taken as the criterion of damage.

Both gases are equally effective in enhancing the damage induced by the radiation. Since restitution is thought to be rare in irradiated metaphase oocytes, the action of these gases is considered as altering a repair mechanism which results in allowing potential damage to become actual. (Auth.)

(Also published as BNL-4981, Brookhaven National Lab., Upton, N. Y.)

- 1075 LaChance, L.E. ENHANCEMENT OF RADIATION-INDUCED STERILITY IN INSECTS BY PRETREATMENT IN CO₂ + AIR. Int. J. Rad. Biol. 7, 4 (1963) 321-31.

When the pupae of the screwworm fly (*Cochliomyia hominivorax* (Coquerel)) are irradiated in an atmosphere of CO₂ + air (50-50 mixture), damage to the reproductive system measured in the adult female is greater than that induced by a similar radiation treatment delivered in air. Doses of γ -radiation ranging from 2500 to 5000 r were investigated. In all tests the number of females ovipositing, the number of eggs per fecund female, and the egg hatchability were reduced. For CO₂ to be effective in enhancing radiation damage air must be present, and the pupae must be pretreated in the gas mixture for approximately 45 min. Complete sterility can be induced by a treatment of 4500 r delivered in CO₂ + air, whereas irradiation in air alone requires about 5500 to 6200 r to induce complete sterility. Irradiation in CO₂ + air is more damaging to the reproductive system than irradiation in pure O₂. (Auth.)

- 1076 Lobbecke, E.A., Oltmanns, O. ON A CHANGE IN THE SPECTRUM OF SOMATIC MUTATIONS IN *Ephestia kuehniella* Z. BY TEMPERATURE TREATMENT BEFORE IRRADIATION. Z. VererbLehre 92 (1961) 246-51.

Pupae were maintained at different temperatures (-7, 3, 30, 35, 40°C) for 6 h before being exposed to 800-r doses of x-rays. The incidence of 4 types of scale mutations (ES 1, ES 2, ES 3, ES 4) in the butterflies was studied. It was found to vary significantly according to temperature. The ratio of ES 1/ES 2 mutations was lowest (5:1) at -7° and highest (11:1) at 35°C. The ES 1 mutant showed highest frequency at 25° and fell to the lowest value after preincubation at 40°C. The ES 2 mutant reached its lowest incidence at 35°. The ES 3 mutant varied inconsistently and ES 4 frequency was only slightly dependent on temperature. The preincubation temperature of 40°C, the lethal limit for the species, generally depressed mutation frequency. The precise reason for the effect of temperature on mutation frequency is unknown but it was previously found that chromosome fragmentation and translocation were reduced at elevated temperatures. (NSA 17:1963, 23206)

- 1077 Markus, B., Sticinsky, E. EXPERIMENTS ON THE EFFECT OF THE ENERGY SPECTRUM OF FAST ELECTRONS ON BIOLOGICAL REACTIONS. Strahlentherapie 115 (1961) 394-403. (In German)

After a survey of the present knowledge about the LET (linear energy transfer) spectrum of fast electrons and of the possibilities for the examination of its influence on biological reactions experimentally, radiation tests with eggs of *Drosophila* with 14.2-MeV electrons are described. The eggs were irradiated in a plexiglass phantom at depths of 100, 30, and 20% of the relative depth dose under specially controlled conditions with the same ionization dose of 200 r (verging on LD₅₀) with 65 r/min. As opposed to the 100% depth, the damage rate at the 30 and 20% depths was 19 to 22% higher. A discussion of the methodic influences, especially of dosimetry, shows a true effect. (Auth.)

- 1078 Markus, B., Sticinsky, E. THE ACTION OF 14-MeV ELECTRONS, 14-MVP AND 200-kVp X-RAYS AND THE INFLUENCE OF THE ENERGY SPECTRUM OF 14-MeV ELECTRONS ON EGGS OF *Drosophila*. (Abstr.) p. 244 in "2nd International Congress of Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The effect of an ionization dose of 200 r on *Drosophila* eggs of mixed ages of 0.5-3 h was described previously for 14 MeV electrons. The LET of the radiation was varied by exposing the eggs at different depths of a Perspex phantom. The depth doses corresponded to 100%, 30% and 20% of the incident beam intensity. The experiments have been extended using eggs of 1 h, 1.75 h and 4 h of age and using 14 MVP and 200 kVp x-rays. Intercomparisons are given for the biological effectiveness of the different radiations used for different depths in the phantom. The RBE varied with the age of the eggs. The effectiveness of the radiations increased with the depth of the phantom. X-rays of both energies were more effective than 14 MeV electrons. This difference was more pronounced the older the eggs at the time of irradiation. Observations are based on doses of 150 r, 300 r and 700 r, and are compared with results of Fritz-Niggli and Schinz.

- 1079 Markus, B., Sticinsky, E. DER EINFLUSS DES ENERGIESPEKTRUMS VON 14-MeV-ELEKTRONEN UND DIE VERGLEICHSWEISE WIRKUNG VON 14-MeV-ELEKTRONEN, 14-MV- UND 200-kV-RÖNTGENSTRAHLEN AUF *Drosophila*-EIER. (The effect of the energy spectrum from 14 MeV electrons, and the relative effects of 14 MeV electrons and 14 MV and 200 kV x-rays on *Drosophila* eggs.) *Strahlentherapie* 120, 2 (1963) 282-8. (In German).
- In experiments on the (LET)-spectrum of fast electrons on biological reactions, a significant effect on damage rate of *Drosophila* embryos (aged 1, 1.75 and 4 h) was found in all 3 age-groups with electrons of 14.2 MeV. The effect was most marked at 4 h when, with an ionization dose of 700 "r", given in a plexiglass-phantom at a depth of 30% relative depth dose, a damage rate of 230% is produced, against 100% at a depth of 100% relative depth dose. The effects of 14 MeV-electron-irradiation at 100% depth showed significant differences for all 3 age-groups, compared with 200 kV or 14 MV x-rays. For an equal ionization dose, the effect of fast electrons was always less than that of x-rays. The differences in efficiency showed a characteristic dependence on age. Between 200 kV and 14 MV x-rays there was no difference at 1 h, but with advancing age increasing differences were observed. The results are compared with those of Fritz-Niggli and Schinz.
- 1080 Martin, V.J., Burson, D.M., Bull, J.C., Cornwall, P.B. THE EFFECT OF CULTURE ENVIRONMENT ON THE SUSCEPTIBILITY OF THE GRAIN WEEVIL *Sitophilus granarius* L. TO GAMMA RADIATION. AERE-R-3893, United Kingdom Atomic Energy Authority. Research Group, Isotope Research Div., Wantage, Berks, England, 1962. 28p.
- The lethal effect of gamma radiation on adult grain weevils is increased by culture densities which cause a substantial rise in metabolic temperature above 26°C during larval development. Densely crowded cultures in which temperatures during growth and maturation of larvae do not rise appreciably above 26°C, fail to modify the adult's lethal response. Temperature fluctuations up to 36°C during development do not modify the susceptibility of the adult to radiation sterilization. Accordingly, the efficacy of 18000 rads for control of grain weevils is unlikely to be reduced by population densities normally encountered in commercial storage. (Auth.)
- 1081 Makino, S. EFFECTS OF RADIATIONS ON CELL DIVISION AND CHROMOSOMES IN ANIMALS. Final Report No.2, 15 Dec. 1961-14 Dec. 1962. AD-403109, Hokkaido Univ., Sapporo, Japan. 12p.
- Effects of radiations on cell division and chromosomes in animals were studied. Effects of x- and β -irradiations on grasshopper spermatocytes were investigated using various chemicals with special regards to their radioprotective effects. X-ray effects on *Drosophila* spermatogenesis were also studied. The remaining investigations were not concerned with insects.
- 1082* Meyer, H.U., Ehrlich, E.F., Muller, H.J. TOLERANCE OF GONIAL CELLS OF *Drosophila melanogaster* FOR HEAVY X-RAY DOSES DIVIDED INTO INSTALLMENTS. (Abstr.) *Genetics* 44 (1959) 527.
- To explore ways of obtaining offspring from heavily irradiated gonidia, x-ray instalments of 1500 r, 3000 r, and 4000 r were given to young imagoes. To promote gonial proliferation, instalments were separated by 2-, 4-, 5- or 8-d intervals, during which the flies fed and reproduced actively. Adult offspring from eggs laid in successive broods after the last irradiation were counted. After female irradiation, only the first two 4-d broods (from treated oocytes) were strongly affected by size of instalment. The earliest broods representing treated gonidia (brood 3 from treated females, broods 4 and 5 from treated males) gave the highest yields. Four-day intervals gave distinctly higher yields than 2-d, but not much lower than 8-d intervals. Tolerance varied greatly with genotype. Thus, with 4000 r instalments 5 d apart, 8000 r sterilized all oögonia of a homozygous stock marked only by veinlet, while 24 000 r allowed some oögonia of normals from outcrosses to reproduce. With similarly given instalments, 12 000 r sterilized all spermatogonia of yellows while 24 000 r allowed some spermatogonia of Stubbles to reproduce. In experiments ranging from 6000 r to 24 000 r, the yield of offspring from treated oögonia was approximately halved by each 3000 r given (as contrasted with 2000 r for the halving dose earlier found when late spermatozoa are irradiated in males). The following sex-linked lethal frequencies were induced in oögonia in the last-mentioned series: 12 000 r (3000 r instalments), 13/244; 18 000 r (4000 r instalments), 15/175; 24 000 r (4000 r instalments), 19/125; that is, 1% per 2000 r. Crossover tests showed these very rarely to include gross structural changes.
- 1083 Mittler, S. AET AND MEA AS PROTECTION AGAINST RADIATION INDUCED CHROMOSOMAL ABERRATIONS IN *Drosophila*. (Abstr.) *Genetics* 48, 7 (1963) 802.

AET or MEA were injected near the testis of *Drosophila* 6 to 12 h after emergence and the flies irradiated with 2000 r of 100 kV x-rays in air. The males were mated at ratio of 1:3 females and transferred to a new group each 3 or 4 d. AET at concentration of 1058 mg/kg did not protect Oregon-R X chromosome as indicated by the M-5 method from recessive sex linked lethals. The brood representing spermatids and spermatocytes at the time of irradiation yielded more mutations than the control. AET did not protect against deletion of the X chromosome of Oregon-R male as shown by induced hyperploidy of attached X females with a γ marker. Injection of MEA at 1411 and 3530 mg/kg did not protect X chromosome of $sc^R Y(\gamma^*)/yB$ males against radiation induced recessive lethals when mated to a multi-purpose stock $\gamma sc^R In49sc^R$, bw, stpP. Again the radiosensitive stages in spermatogenesis, the spermatids and spermatocytes, are induced to produce more rather than less mutations. MEA did not protect against radiation induced translocations between chromosomes 1 and 3. (From abstr.)

- 1084 Mittler, S. STUDIES OF CHEMICAL PROTECTION AGAINST RADIATION INDUCED MUTATIONS. (Abstr. B1B330) p.37 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC, July 1963.

Sulfhydryl compounds, which are effective in protecting mammals from death by irradiation will be studied with respect to chemical protection against induced mutations, and chromosome translocations, and deletions in *Drosophila melanogaster*. MEA, 2 mercaptoethylamine, and AET, 2 aminoethylisothiouonium bromide, will be injected near the testes of the fly which will then be irradiated with 2000 r from an x-ray source. Recessive sex linked lethal mutations will be determined by the M-5 method and translocations between II and III chromosome by bw: st method. The protection, if any, against deletions of the X chromosome will be determined by the (attached) X method. Preliminary experiments indicate that the sulfhydryl compounds are not protecting against genetic damage, but are enhancing it. This may be due to some inhibition of a recovery process.

- 1085 Mossige, J. OXYGEN-EFFECT ON MUTATION-RATE INDUCED IN DIFFERENT STAGES OF SPERMIOGENESIS IN *Drosophila melanogaster* BY 31-MeV ELECTRONS AND 180-kV X-RAYS. (Abstr.) p.244 in "2nd International Congress of Radiation Research, Harrogate, Yorkshire, England. 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The purpose of the present investigation is to determine whether the oxygen-effect on *Drosophila* sperm could be modified by LET. A comparison is made between the brood patterns obtained by irradiating newly eclosed males with 31-MeV electrons from a betatron, and 180-kV conventional x-rays in an atmosphere of oxygen or of nitrogen. The electron doses are measured with a Baldwin Farmer substandard dosimeter, and the x-rays with a Duplex integrating dosimeter. The males are mated each day with 5 new females and the progeny tested for recessive sex-linked lethals by the standard Basc method. Peak sensitivity is usually found on the 5th day, and this day also reveals the greatest modification of sensitivity by both O_2 and N_2 . In an experiment with a dose of 375 r in O_2 and 750 r in N_2 , the O_2 enhancement factor for Day 5 was 2.5 for x-rays and 3.8 for electrons, while it was about 1 on Day 1 with x-rays and with electrons. Preliminary experiments at higher doses indicate an even greater enhancement on Day 5. Further experiments are in progress to confirm this finding.

- 1086 Mossige, J. DIFFERENTIAL YIELDS OF MUTATIONS FROM THE FIRST AND SECOND MATINGS AFTER IRRADIATION OF MATURE SPERM IN *Drosophila melanogaster*. (Abstr.) *Hereditas* 48, 3 (1962) 543. See 1087.

- 1087 Mossige, J.C. DIFFERENTIAL YIELDS OF MUTATIONS FROM THE FIRST AND SECOND MATINGS AFTER IRRADIATION OF MATURE SPERM IN *Drosophila melanogaster*. p.263-74 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Young males yield lower frequencies of sex-linked lethals and II to III translocations over the age range tested, from newly eclosed to 7 d for lethals and from newly eclosed to 3 d for translocations. The first sperm available in the newly eclosed males, 0 to 4 h old, yield the same frequencies of both translocations and sex-linked lethals when irradiated in nitrogen or air, but the frequencies are enhanced in oxygen. When the sperm have been stored for 3 d in the male there is both a decrease in N and an increase in O as compared to air. It is concluded that the most mature sperm in 0 to 4-h-old males are relatively anoxic. When irradiated in N, air, or O these young sperm give a decreased frequency of sex-linked lethals from the 1st to the 2nd mating with single females, and a continued decrease of the lethal frequency with time up to about 24 h. Sperm irradiated in 2 d-old males in air also show a marked decrease from the 1st to the 2nd mating and a further decrease in the frequency with time up to about 9 h. In 7-d-old males there

is a decrease from the 1st to the 2nd mating immediately after irradiation but no further decrease with time. In 3-d-old males irradiated over a dose range of 445 to 3000 r in air, N, and O there was a tendency toward a decrease from the 1st to the 2nd matings, within 5 h, in air and O, but none in N. It is suggested that the decrease often observed between 1st and 2nd sperm batches is due both to a difference in O sensitivity between the first sperm available and those next in line in males of all ages, and to a recovery with time of all mature sperm from males at least up to 2-d-old, which is independent of the atmosphere in which the irradiation was performed. (Auth.)

- 1088 Müller, I. CHANGES IN THE MUTATIONAL SPECTRUM OF SOMATIC MUTATIONS IN *Ephestia* BY PRE-TREATMENT WITH LOW AND HIGH TEMPERATURES. p.154 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Scales on the hind wings of *Ephestia kuehniella* are of uniform shape and colour. After irradiation of pupae, single mutated scales of different appearance are found. There are 4 kinds of mutant scales, each one with a characteristic mutation rate after irradiation in a standard environment. In a pilot experiment Lötbecke and Oltmanns found that it is possible to change the relative frequencies of these mutant types by variation of the temperature before irradiation. In order to ascertain this effect and to gain a better insight into its nature, the dose-relationships were studied. Pupae were kept at +3°C or +35°C respectively for 8 h and were then irradiated with one of 6 x-ray doses between 100 and 1000 r. For each point of the dose-effect curves 375 000 scales were examined. The experiment was repeated once. The shape of the dose-effect curves for each mutation was the same, regardless of the kind of pre-treatment, but the level of the curves of the types ES1 and ES3 was considerably lower in the 3°C-series, whereas for ES2 and ES4 it remained the same or was even higher than in the 35°C-series. In consequence, the relative frequencies of the 4 types, i.e. the mutational spectra, were changed by different pre-treatments in the same proportion over the whole dose range tested.

- 1089 Muller, H.J., Oster, I.I., Zimmering, S. ARE CHRONIC AND ACUTE GAMMA IRRADIATION EQUALLY MUTAGENIC IN *Drosophila*? p.275-311 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Drosophila oögonia were irradiated with Co^{60} γ and the progeny studied for the appearance of sex-linked lethals. When doses and dose-rates were gaged by means of physical dosimetry alone it was found that a given dose induced about 1.6 times as many sex-linked recessive lethals in the immature oögonia of adult *D. melanogaster*, when they were irradiated at their lowest or dead level stage of sensitivity, if the radiation were delivered in the form of a single acute dose in about half a minute, at 44×10^4 r/h, as it did if it were delivered in the form of a chronic dose extending over 2 weeks, at 12 r/h. Again using only physical dosimetry, doses of 4000 r delivered at lower rates, extending down to 1.5 r/h, gave no evidence of a further drop in the mutagenic effectiveness of the radiation. Still using only physical dosimetry, the results of 4000 r delivered at dose-rates measured as being in the range of 120 to 60 r/h showed good agreement with the results of the acute irradiation, and highly significant disagreement with those of the irradiation at 12 r/h and lower, when the irradiations in the 120 to 60 r/h range were carried out in the so-called hot room of the Brookhaven National Laboratories. On the contrary, when the irradiations in the 120 to 60 r/h range were carried out in the so-called dilution room, the observed frequencies of induced lethals showed good agreement with those obtained for 12 r/h and lower, and highly significant disagreement with those of the acute irradiation. A series of irradiations of spermatozoa in inseminated females was carried out in order to determine to what extent the frequencies of recessive sex-linked lethals induced in these well-studied stages corresponded with the expectations based on the physical dosimetry. It was found that the frequencies obtained from acute irradiation in the hot room, and also from chronic irradiation, at 12 r or less per hour, in the dilution room, were some 90% ($\pm 5\%$) as high as expected for the supposed doses. In contrast to these results, the frequencies obtained from chronic irradiation at intended rates of either 60 or 12 r/h in the hot room were about 120% ($\pm 5\%$) of those expected for the supposed doses. Application of correction factors for the doses used would remove all decisive differences in the per-r lethal frequencies. However, 12 r/h given in the hot room was reckoned by this method to have only half the mutagenic effectiveness shown by all these other treatments. A series of irradiations was thereupon carried out in which both spermatozoa in the female and oögonia were irradiated simultaneously. Most of the values directly observed for oögonia agreed satisfactorily with those obtained previously. However, after application of correction factors based on the results from the spermatozoa simultaneously given the same treatment, other values for oögonia were obtained. The 12 r/h irradiation in the hot room, giving a calculated lethal frequency of only 0.9%, appeared to be only about 0.4 as effective as the acute irradiation, and 0.7 as effective as chronic irradiation given in the dilution room. In an attempt to throw light on the discrepancy, as well

as on lesser yet significant discrepancies in other cases, extensive tests were carried out of the possible influence of the following factors: delay in germ-cell maturation caused by irradiation or otherwise; natural differences in reproductive activity; differences in nutrition; presence or absence of a presumptive radioprotective agent (AET); exposure in center or near periphery of radiation field. None of the results indicated that any of these factors had affected the mutation frequency. (Auth.)

- 1090 Muller, H.J. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN *Drosophila*. (Abstr. B1F359). p. 51 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

In order to throw light on the relative mutagenicity of chronic versus acute γ irradiation, the mutation frequency among offspring derived from eggs laid different lengths of time after irradiation of the female will be further investigated. Pre-imaginal and imaginal stages will be irradiated chronically and acutely, in a study of mutagenicity at these stages. Solutions of radionuclides will be used for delivering radiation at controlled rates. The effect of the pre-imaginal irradiations on survival and the life span of the exposed flies will also be studied, in order (among other things) to throw light on the influence of dose fractionation on the effectiveness of the radiation in producing damage of this kind. A series of other experiments designed to investigate the kinds of genetic basis underlying the damaging effects of x or γ radiation on survival and the life span will be carried out. These will involve the use of diverse specially constructed genetic stocks. The investigation of the question whether spermatozoa held in the male after irradiation undergo a natural pre-mutational repair, protracted over some 24 h, will be carried further. The study of the effect of anoxia (nitrogen) pre- and post-treatments on radiation mutagenesis will be carried further. Work will be continued on peculiarities of heterochromatin in undergoing radiation-induced structural changes.

- 1091 Murakami, A., Tazima, Y. MODIFICATION OF X-RAY INDUCED MUTATIONS IN *Bombyx mori* L. BY PRE- AND POST-IRRADIATION TREATMENT WITH 5-BROMOURACIL. A preliminary report. (Abstr.) *Jap. J. Genet.* 37 (1962) 400. (In Japanese)

- 1092 Nair, K.K., Subramanyam, G. EFFECTS OF VARIABLE DOSE-RATES ON RADIATION DAMAGE IN THE RUST-RED FLOUR BEETLE, *Tribolium castaneum* HERBST. p.425-9 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

In order to find out whether a change in dose-rate would significantly alter a radiation response, eggs as well as the adults of *Tribolium castaneum* were tested for viability and fertility respectively after exposure to γ -radiation at different dose-rates. The doses employed were 2000 and 5000 rad and the dose-rates ranged from 126 rad/h to 140 000 rad/h. It was observed that with an increase in dose-rate there was a decline in the fertility of the adults. Similarly the viability of the eggs was considerably reduced as the dose-rate increased, but at very high dose-rates there was a significant increase in viability. The significance of these findings is discussed. (Auth.)

- 1093 Nakanishi, Y.H., Makino, S., Ohnuki, Y. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION ON THE CELL, WITH SPECIAL REGARD TO THE BEHAVIOR OF THE CHROMOSOMES IN GRASSHOPPER SPERMATOCYTES IN RESPONSE TO X- AND BETA-IRRADIATIONS. p.115-35 in "Proceedings of the Symposium on Genetic Effect of Radiation, Mishima, 7-8 November 1960". *Jap. J. Genet.* 36, Suppl. The Genetics Society of Japan. 1961. (In English).

The major portion of the study was carried out on the 1st and 2nd spermatocytes of *Podisma sapporensis*, supplementary data having been obtained from *Chrysopa japonicus*, *Chorthippus bicolor*, and *Oxya yezoensis*. Results are given for (1) x-irradiation with whole body exposure (when chromosomes completed the equatorial arrangement in a seemingly regular manner but failed to separate or formed sticky bridges at anaphase); (2) β -irradiation of individual cells at selected stages (sensitivity was measured in terms of chromosome stickiness and found to decrease in order of diakinesis, metaphase and anaphase); and (3) β -irradiation of parts of individual cells. The need for further work is stressed.

- 1094 Nicoletti, B., Olivieri, G. INTERACTION OF X AND ULTRAVIOLET RADIATION IN PRODUCTION OF RECESSIVE LETHALS IN *Drosophila melanogaster*. *Atti Ass. genet. ital.* 7 (1962) 180-90. (In Italian, with English summary).

The possibility that uv rays given to different biological systems before or after x-rays could modify genetic or cytological effects is reviewed and discussed. Kaufmann and Hollaender's conclusions about

the recovering effect of uv rays on chromosomal damage induced in *Drosophila* sperms by a pre-treatment of x-rays are discussed and analyzed taking into account some general considerations. Preliminary results of similar experiments on the frequency of sex-linked recessive lethals induced after single and combined x + uv treatments in *Drosophila* sperms are reported. All our experiments indicate no effect of the uv treatment (at the given wave lengths and doses) in lowering the frequency of the x-ray-induced recessive lethals. On the contrary, there are some indications for a synergistic action between the two radiations. These results not in agreement with the generally accepted theory that uv rays do recover x-ray-induced chromosomal damages, could be explained with the well established correlation between chromosomal rejoined breaks and genic mutations. (Auth.)

- 1095 Oberheuser, F., Künkel, H.A. ULTRAFRAKTIONIERUNG UND RELATIVE BIOLOGISCHE WIRKSAMKEIT SCHNELLER ELEKTRONEN. VERSUCHE AN *Drosophila* EMBRYONEN VERSCHIEDENER ENTWICKLUNGSSTADIEN. (Ultrafractionation and relative biological effectiveness of fast electrons. Experiments on *Drosophila* embryos at different stages of development). *Biophysik* 1 (1963) 11-19. (In German, with English summary).

A 15-MeV-betatron was used. By means of a special electronic device it was possible to quench radiation pulses in the injector of the accelerator. The frequency of radiation pulses thus varied between 2 and 50 pps. The ultra-fractionated radiation was compared with the continuous radiation from a 1000-c Co⁶⁰-source. The influence of ultrafractionation on the RBE of fast electrons was tested on *Drosophila* eggs aged 1½, 4½, and 6 h (at least 2000 eggs being tested for each stage). The average dosage rate or the dose of the particular radiation pulses was kept constant. Dose-effect curves show a significant influence of the pulse frequency on the percentage of killed eggs, possibly due to the existence of a recovery effect.

- 1096 Oster, I.I. ON RECOVERY IN X-IRRADIATED GERM CELLS. *J. cell. comp. Physiol. Suppl.* 1 58 (1961) 203-7. Symposium on "Recovery of Cells from Injury, Gatlinburg, Tennessee, 3-6 April 1961". Philadelphia, The Wistar Institute of Anatomy and Biology. 1961.

After defining "recovery", the author suggests that spermatozoa located in different sections of the reproductive tract (male or female) are differentially oxygenated. He proposes that differential radiosensitivity is in all likelihood responsible for differences which have been observed following x-irradiation of sperm. Some data is also given for irradiation with neutrons.

- 1097 Oster, I.I., Pooley, E., Schwarz, R. THE FREQUENCY OF MOSAIC MUTATIONS INDUCED BY GAMMA RAYS AND NEUTRONS. (Abstr.) *Genetics* 47, 8 (1962) 975.

Homogeneous samples of mature spermatozoa (from inseminated females) were treated with sparsely ionizing radiation (γ-rays from a Co⁶⁰-source) and densely ionizing radiation (fast neutrons) and the incidence and mode of expression of mutations induced at the dumpy locus were analyzed. A γ-dose of 4000 r (delivered at the rate of 200 000 r/h) yielded 64 mutations at the dumpy locus amongst 13 100 offspring (0.49%); 18 of these were mosaics (28%). A neutron dose of 750 rads yielded 52 mutations at the dumpy locus amongst 22 960 offspring (0.23%); 16 of these were mosaics (31%). These results resemble those obtained with x-rays (Carlson) but differ significantly from the 80-90% incidence of mosaics following treatment with chemical mutagens. Thus differences in LET do not result in different frequencies of induced mosaics, and unlike chemicals, ionizing radiation tends more often than not to affect both DNA strands while traversing the chromosome. In addition, preliminary results with x-irradiated spermatocytes and spermatids have indicated that although mosaics can be induced occasionally in these stages the frequency of such mosaics is similar to that produced by irradiation of spermatozoa. (From abstr.)

- 1098 Oster, I.I. THE MUTATIONAL SPECTRUM WITH SPECIAL REFERENCE TO THE INDUCTION OF MOSAICS. p. 51-8 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

By the use of special multipurpose stocks of *Drosophila melanogaster* and refined breeding techniques the effects of several conditions existing at the time of irradiation were investigated. In addition to information gained concerning the frequencies of induced chromosome breakage, lethal mutations, and translocations, which were in line with previous results, it was found that γ-rays, x-rays in air or oxygen, and neutrons produce relatively low frequencies of mosaic mutations while irradiation under anoxic conditions results in fairly high proportions of mosaic individuals. (Auth.)

- 1099 Oster, I.I. MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. Annual Progress Report and Renewal Proposal for the Period September 1, 1962 to August 31, 1963. TID-16026, Institute for Cancer Research, Philadelphia. 1963. 13p.
- Progress is reported in studies on the genetic effects of radiation in *Drosophila*. Such aspects as induced crossing over and non-disjunction, differences in the effects of acute and chronic irradiation, and effects of ionizing radiation of different LET transfer properties, delivered under various conditions, were studied. Several innovations and techniques are described that were introduced with a view to increasing the degree of refinement in the detection of induced hereditary changes.
- 1100 Oster, I.I. MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. Progress Report. 1 Sept. 1960-30 Nov. 1963. TID-19991, Institute for Cancer Research, Philadelphia. 1963. 29p.
- An attempt was made to define the spectrum of effects that radiation of different LET properties (x, γ , fast neutrons) can produce in the genetic material of the fruit fly. Pre-imaginal stages and inseminated females proved the best source of homogeneous male germ cells. The relative sensitivity to γ -rays of spermatids in pupae and of spermatozoa in females was studied by a method similar to that used for determining the spectrum of sensitivity of germ cells to x-rays. A similar sensitivity to x- and γ -rays was obtained. Differences in mutation frequency among spermatozoa x-rayed in the female and in the male (but released on days following irradiation) appear due to differential oxygenation during treatment and hence to radiosensitivity rather than to recovery, supported by results obtained from neutron irradiation. Spermatids appear to be relatively less sensitive to neutrons than to x-rays. Results are also cited for various treatments (3000 r/min x-irradiation of spermatids, at the pupal stage in air; γ -irradiation of mature spermatozoa in inseminated females in 100% O₂; 100% N₂; 100% He₁ by fast neutrons in air). The LET difference between γ -rays and neutrons does not result in different frequencies of induced mosaics. The interactions between fast neutrons and x-rays were studied in mature spermatozoa. The effects appear to be additive for lethals but no interaction between breaks was observed. Work on (x-rays, fast neutrons) induced crossing-over are also described. Studies are under way to determine effects of varying radiation dosage, LET properties, and accessory conditions on non-disjunction in the female; and also on mutagen-induced mortality. Cytological observations are described.
- 1101 Oster, I.I. MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. (Abstr. B1E301) p. 45 in "Research and Development in Progress, Biology and Medicine. Issue No. 1", TID-4200, Division of Technical Information, AEC. July 1963.
- Experiments aimed at modifying the genetic damage produced by ionizing radiation will be continued using the reproductive cells of *Drosophila melanogaster*. Our studies on induced crossing-over and non-disjunction will be extended. Several new stocks will be utilized in order to pinpoint more exactly the regions of the chromosomes which are differentially affected as regards crossing over by different conditions existing during irradiation. In addition, experiments to determine the extent to which chronically-delivered radiation affects crossing over and non-disjunction will be undertaken. It is planned to extend our analyses of the effects produced by types of ionizing radiation characterized by different LET properties (i.e., γ -rays, x-rays and neutrons) in the genetic material when delivered at different doses and under different conditions. Special emphasis will be placed on determining the relative incidences of induced mosaic and whole-body mutations. The frequencies of such changes will also be studied following the exposure of germ cells to chronically-delivered radiation with a view to detecting the presence of repair mechanisms. In addition, with the aid of a newly developed cytological technique for studying somatic chromosomes we hope to be able to investigate the effects of relatively low doses of radiation, differences between acutely- and chronically-delivered radiation, and the effects of chemical mutagens.
- 1102 Paik, Y.K., Kim, T.S., Sung, K.C. PRELIMINARY REPORT ON THE EFFECT OF CYSTEINE ON THE RATE OF X-RAY INDUCED MUTATIONS IN *Drosophila melanogaster*. J. nucl. Sci. 2 (1962) 37-40. (In English).

The protective effect of cysteine against the production of sex-linked recessive lethals in *Drosophila* sperm by x-irradiation was investigated. It is shown that the cysteine injection prior to irradiation apparently reduced the production of sex-linked recessive lethals. The protecting action of cysteine can be ascribed to the oxygen starvation produced by its easily oxidized-SH groups during irradiation. (NSA 17:1963, 35528)

- 1103 Pendlebury, J.B., Sanham, E.J., Cooper, B.E., Bland, C.M. THE INFLUENCE OF TEMPERATURE UPON THE RADIATION SUSCEPTIBILITY OF *Sitophilus granarius* L. AERE-R-3641, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1962. 38p.
- The factorial experiment was carried out to examine the effects of high and low temperatures (15°C and 30°C) before, during and after irradiation, on the susceptibility of the adult grain weevil to doses in the range 3000 to 20 000 rads. **Mortality:** A high temperature before irradiation sensitises the insect to subsequent irradiation, reflected in greater mortality, whereas a low temperature affords some protection. During irradiation these effects are reversed; a low temperature sensitises and a high temperature exerts a protective influence. Under both conditions the maximum effect is observed at doses between 3000 and 10 000 rads. After irradiation, a high temperature increases the rate of mortality; at low temperatures it is retarded, this last effect being independent of dose. **Sterility:** Differences of 15-30°C before, during and after irradiation do not modify the susceptibility of grain weevils to radiation sterilisation. The minimum dose for control of grain weevils (18 000 rads) would be effective at all temperatures likely to be encountered in commercial practice. (Auth.)
- 1104 Podolyan, V. Ya. PATHOGENIC EFFECT OF LOW AND MEDIUM DOSES OF GAMMA-RAYS ON THE PROGENY OF IRRADIATED INSECTS. Trud. Inst. Zool., Akad. Nauk. Kaz. SSR 19 (1963) 220-5. (In Russian). English Translation: JPRS-22107.
- Data are presented on the effects of low and medium doses of Co⁶⁰ γ -radiation on adult spring carrion flies (*Protophormia terrae novae*) and on the progeny of these insects from the 1st to the 5th generation. Fifteen experiments used various radiation doses from 100 to 1500 r and combinations of irradiated males, irradiated females, or both irradiated males and females. The mortality rate among insects irradiated with 100 r was higher than that of mature insects exposed to higher doses. The percentage of unfertilized eggs and mortality rate of the pre-imaginal stages increased with the intensity of the radiation dose to the maternal generation of mature flies. Possible applications of radiation in the control of insect pests are discussed. (NSA 18:1963, 5010)
- 1105 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. FREQUENCY OF RECESSIVE SEX-LINKED LETHALS IN *Drosophila melanogaster* SPERMATOGENESIS, IN O₂, N₂, AND AIR, WITH 600 r AND 1200 r. *Drosophila Inf. Serv.* 36 (1962) 111-2.
- See 1107.
- 1106 Paulov, Š. EFFECT OF A LOW TEMPERATURE ON THE DEVELOPMENT OF RADIATION INJURY IN EGGS OF THE SILKWORM *Bombyx mori* L. *Folia biol., Prague* 7 (1961) 281-4. (In English)
- Experiments were made to determine whether the cooling of irradiated eggs during the diapause would moderate the effects of radiation in eggs of the silkworm. The degree of injury to the irradiated eggs was evaluated from the percentage of larvae hatched and from the time course of hatching. It was found that a low temperature moderated the effects of radiation. Injury was less when the eggs were irradiated before being placed in the refrigerator than when they were irradiated after being removed from the refrigerator. It is suggested that the difference in injury is related to metabolic changes. (NSA 15:1961, 30467)
- 1107 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. THE EFFECT OF X-RAY TREATMENT COMBINED WITH AIR, NITROGEN, OR OXYGEN IN *Drosophila melanogaster* STUDIED ON SEX-LINKED RECESSIVE LETHALS. *Atti Ass. genet. ital.* 7 (1962) 170-9. (In Italian, with English summary).
- Germ cells of spermatogenesis of *D. melanogaster* were treated with 600 r of x-rays. The sensitivity spectrum for recessive sex-linked lethals, obtained by crossing the treated males for 12 successive days, shows a maximum in days 5 to 7, corresponding to treated spermatids; this confirms data already known. Anoxia lowers the sensitivity throughout the whole spectrum, particularly for spermatids; O₂ treatment increases x-ray damage, although not uniformly in the different stages of spermatogenesis: the less sensitive cells under these circumstances are spermatids and spermatogonia. (Auth.)
- 1108 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. DIFFERENTIAL SENSITIVITY OF SPERMATOGENIC STAGES OF *Drosophila melanogaster* TO X-RAY IRRADIATION IN O₂ AND N₂. (Abstr.) p.187 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.
- By scoring recessive sex-linked lethals in repeated single matings of x-ray-treated *D. melanogaster* males to 3-Muller-5 females, with mating periods of 24h, a sensitivity spectrum is obtained for the different

spermatogenic stages present in the testis at the moment of irradiation. With the aid of the sterility criterion and by comparison with other authors' data, it is possible to correlate the mutation frequencies with treated germ-cell stages. The results for the air treatment are in agreement with known data, giving a peak mutation frequency on the 6th day after treatment, corresponding to treated spermatids. If the flies are kept in an atmosphere of O_2 or N_2 from 45 min before to 45 min after irradiation, mutation frequencies in different cell stages are modified to a different extent. Anoxia, which shows a reducing effect on all stages, acts more strongly on stages giving highest mutation frequency in air. The effect of oxygen, on the other hand, is mainly restricted to mature stages utilized on days 1-4 after treatment, and to stages which we interpret as representing meiosis (7-10 d after treatment). Spermatids are least sensitive to an increase in O_2 concentration. A metabolic effect of the presence of different gases, as well as a different physiological content of O_2 , could be responsible for the differential modifying action of O_2 and N_2 on the mutation frequency spectrum.

- 1109 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. DIFFERENTIAL SENSITIVITY OF SPERMATOGENETIC STAGES OF *Drosophila melanogaster* TO X-IRRADIATION IN O_2 AND N_2 . (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 380-1.

(Essentially as for 1108)

- 1110 Purdom, C.E., McSheehy, T.W. DOSE-RATE AND THE INDUCTION OF MUTATION IN *Drosophila*. Int. J. Rad. Biol. 7, 3 (1963) 265-75.

Drosophila male germ cells were exposed to 800 rad of Co^{60} γ -rays at 0.05, 0.5 and 5.0 rad/min. F_0 males were mated in 7 successive broods of which broods I and VII were sampled for IInd chromosome recessive lethal mutations. Mutation frequency was independent of dose-rate in each brood. It was concluded that dose-rate had no discernible effect on induced mutation frequency in spermatids (brood I) or spermatogonia (brood VII). These results are discussed in relation to the hypothesis that the dose-rate effect discovered by Russell in the mouse arose through repair of genetic radiation damage. It is suggested that killing of cells by radiation, which is much more extensive in the mouse than in *Drosophila*, would be a more plausible mechanism to explain the dose-rate effect than repair, for which there is no corroborative evidence. (Auth.)

- 1111 Purdom, C.E., McSheehy, T.W. RADIATION INTENSITY AND THE INDUCTION OF MUTATION IN *Drosophila*. Int. J. Rad. Biol. 3, 6 (1961) 579-86.

A study was made of the effect of intensity of irradiation on the production of IInd chromosome lethal mutations in spermatogonia and spermatids of *Drosophila*. No intensity effect was detected between x-ray doses of 3000 r given at 600 r/min and 2.0 r/min respectively, or Co^{60} γ -ray doses of 3000 r given at 2000 r/min and 2.0 r/min respectively. A comparison between the effect of Co^{60} γ -rays given at 2.0 r/min and 0.01 r/min at a total dose of 200 r showed that a slight intensity effect might be operative in spermatogonia but that this was very much less than that observed by Russell in the mouse over a comparable dose-rate range. (Auth.)

- 1112 Purdom, C.E. THE EFFECT OF INTENSITY AND FRACTIONATION ON RADIATION-INDUCED MUTATION IN *Drosophila*. p.219-30 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press, 1963.

The effect of radiation intensity on the induction of mutation was studied in *Drosophila*. Male germ cells were exposed to radiation intensities ranging from 0.01 to 2.6 r/min. No intensity effect was observed when irradiation was received primarily by spermatocytes and spermatids. Similarly, no intensity effect was observed in spermatogonia over the range 0.05 to 2.6 r/min. Irradiation at 0.01 r/min did, however, produce a significantly low mutation frequency in one experiment. This may indicate the presence, at very low dose-rates, of an intensity effect in spermatogonia, but the single observation was not regarded as conclusive. Attempts to examine the effect of dose-fractionation in the light of possible intensity effects were rendered inconclusive by the absence of an intensity effect in parallel experiments. (Auth.)

- 1113* Ray-Chaudhuri, S.P., Saha, A.K. PROTECTIVE ACTION OF VERSENE AGAINST RADIATION DAMAGE TO GRASSHOPPER CHROMOSOMES. Proc. nat. Inst. Sci., India 26B (1960) 6-10.

The effect of treatment with Versene (I) solution before irradiation on the frequency of chromosome breakage was determined by counting the number of dicentric bridges in the first meiotic anaphase divisions of the testes of the grasshopper, *Gesonula punctifrons*. In the controls (treated with 0.67% saline plus 86 r

of x-rays), 10.8 ± 0.27 bridges were recorded as compared with $8.29 \pm 0.61\%$ in the treated series (10^{-8} M I in 0.87% saline plus 86 r of x-rays). The unirradiated I-treated group showed no bridges in 801 first anaphase cells. It was concluded that I is a definite though feeble protector of radiation-induced chromosome breaks in their material. (CA 56:1962, 789b)

- 1114 Ray-Chaudhuri, S.P., Chaudhuri, J.P., Chatterjee, S. CYSTEAMINE PROTECTION OF GRASSHOPPER CHROMOSOMES FROM X-RAY-INDUCED ABERRATIONS UNDER AEROBIC AND ANAEROBIC CONDITIONS. Int. J. Rad. Biol. 5, 6 (1962) 591-5.

The effect of cysteamine pre-treatment on the frequency of x-ray-induced chromosome aberrations was determined under both aerobic and anaerobic conditions by counting the dicentric bridges in the first division meiotic anaphase of the grasshopper, Gesonula punctifrons. Under aerobic conditions in the cysteamine-treated animals 20.73% bridges were scored as compared with 30-90% in the controls. Under anaerobic conditions the scores were 5.35% and 8.22% in the treated and controls, respectively. Thus the degree of protection by cysteamine under both aerobic and anaerobic conditions was found to be more or less the same. The possible mode of protection has been discussed. (Auth.)

- 1115 Reddi, O.S. THE GENETICAL RESPONSE OF RADIATION SPERMATOCYTES TO DIFFERENT TYPES OF RADIATION TREATMENT. Int. J. Rad. Biol. 7, 3 (1963) 301-5.

Drosophila spermatozoa were exposed to x-rays in air, x-rays in N_2 and neutrons in air. Each treatment was given either to males or inseminated females. After x-irradiation in air the frequencies of sex-linked lethals and translocations were highest among the progeny of treated inseminated females, lower in the 1st day progeny of treated males, and lowest in the 2nd-day progeny of treated males. After x-irradiation in N_2 or after neutron radiation, all 3 frequencies were the same. This suggests that both differences (male versus female treatment; 1st versus 2nd day) have the same basic cause. Experiments in which x-rayed males were mated after 1 or 2 d of storage without females indicate that this cause is differential radiosensitivity between fully and nearly mature spermatozoa. (Auth.)

- 1116 Rinehart, R.R. SOME EFFECTS OF NITRIC OXIDE AND OXYGEN ON DOMINANT LETHAL PRODUCTION IN X-IRRADIATED Drosophila virilis MALES. Thesis. Texas Univ., Austin. 1962. 73p.

Drosophila virilis males were treated with various x-ray doses in the presence of small amounts of O_2 , NO, or a combination of the gases. The effects upon sperm survival were tested at a warm temperature, 23-25°C, and at a cold temperature, 3-5°C. Control experiments were conducted in anoxia and in air at similar x-ray doses and temperatures. The treated males were mated for 5 d and then mated to 3 heterozygous females for successive 2-d mating periods. The number of eggs laid each day was recorded. Irradiation damage in males was enhanced approximately the same whether 1, 2, or 3% NO was used as the test-gas. This was true at either the 500 or 1000 r level of x-radiation. One atmosphere air, at 23-25°C, or 3% O_2 , at 3-5°C, showed a similar amount of damage, with similar x-ray doses, as was observed when small amounts of NO were used. A lower temperature did not appear to alter the x-ray damage when the flies were treated with NO or anoxia. However, at 3-5°C irradiation damage was greatly enhanced when 3% O_2 was used as the test-gas. Flies were treated in a mixture of NO, O_2 , and NO_2 prepared by mixing 3% NO and 3% O_2 . Through hydrolysis of the NO_2 , nitric and nitrous acids were presumably formed within the cell. At room temperature the amount of damage under these conditions was intermediate to that observed in the NO tests and tests conducted in anoxia. By lowering the temperature, the amount of damage was increased. The amount of lethality usually associated with 2 or 3% NO and 500 r was decreased if, immediately after irradiation in NO, the flies were post-treated with 1 atm. O_2 . A 6-d period during which no eggs developed from females mated with males treated with 3% NO was due to a lack of mature sperm rather than to complete lethality. No definite conclusions were reached regarding mechanisms of enhancement of x-irradiation damage in males by NO. A number of experiments are pointed out that might resolve more completely the mode or modes of action of NO in the system. (Diss. Abstr., 23: 1962, 1839-40)

- 1117 Rinehart, R.R. SOME EFFECTS OF NITRIC OXIDE AND OXYGEN ON DOMINANT LETHAL PRODUCTION IN X-IRRADIATED Drosophila virilis MALES. Genetics 48, 12 (1963) 1673-82.

The ability of small amounts of NO or O_2 to increase dominant lethality was tested. (See 1116). It appears that when equal amounts of either NO or O_2 are present within the spermatogenic cells being tested, equal amounts of either gas cause equivalent increases in damage. In the presence of NO and O_2 , which will react to form NO_2 , much of the effect of both gases to increase x-ray damage was reversed. Neither NO nor its hydrolysis products, nitric or nitrous acid, appear to be the major mutagens in this system; O_2

post-treatment immediately after irradiation in 2% or 3% NO reverses some of the damage. NO appears to modify the post-irradiation survival of the males.

- 1118 Rudnicki, T. THE RELATIVE BIOLOGICAL EFFECT OF P^{32} β RADIATION. I. COMPARISON OF P^{32} β RADIATION AND X-RAYS AS TO THEIR BIOLOGICAL EFFECTS ON Drosophila melanogaster. Acta phys. polon. 12, 1 (1961) 154-7. (In Polish, with English and Russian summaries)

The influence of physical and biological factors on the biological efficiency of ionizing radiation was studied. The results of comparative studies on the biological effects of 70 kV x-rays and P^{32} β -radiation on D. melanogaster eggs 1 \pm 1/4 and 3 \pm 1/4 h old are given. No differences in biological effects were found between the 2 types of radiant energy. (Auth.)
- 1119 Sado, T. DIFFERENCES IN RESPONSE OF SILKWORM GONIA TO ACUTE AND CHRONIC γ -IRRADIATIONS. (Abstr.) Jap. J. Genet. 36 (1961) 393. (In Japanese)
- 1120 Sado, T. DIFFERENCES IN RESPONSE OF SILKWORM GONIA TO ACUTE AND CHRONIC γ -IRRADIATION. Annu. Rep. nat. Inst. Genet., Mishima. 1961 12 (1962) 90-1.
- 1121 Sävghen, R. THE FREQUENCY OF XO MALES AND INDUCED AUTOSOMAL CROSSOVERS AFTER IRRADIATION OF Drosophila melanogaster MALES IN AIR OR COMMERCIAL NITROGEN. Hereditas 47 (1961) 23-42.

Results are reported from an investigation of the frequency of induced XO males and induced autosomal crossovers in meiotic and premeiotic stages in Drosophila after irradiation of 0 to 1-d-old males. The effect of irradiation under anoxia upon the yield of XO males and upon the rate of induced autosomal crossovers was also studied during the period of highest sensitivity to x-ray irradiation. By use of a dual-purpose stock it was possible to study both aberrations in the same stock. It is shown that there is a significantly lower rate of induced XO males in experiments performed under anaerobic conditions compared to those irradiated in air. It is furthermore obvious that the difference is most drastic in mating periods corresponding to the highest sensitivity. In order further to study the effect of irradiation under anaerobic conditions two experiments were performed where the dose was divided into two parts. The first part consisted of 1100 r in commercial nitrogen with an interval of 15 and 60 min, respectively, in air, where-upon the second part, 700 r in air, was given. The results indicate that there is some recovery after irradiation of the sensitive stages but that it could be only partly blocked by 700 r given in air within 15 min. That the reduced effect of irradiation under anoxia is not limited to XO males is obvious from the crossing-over study. The observed crossover data fit well with the sensitivity pattern obtained through XO studies. Spermatozoa available for insemination on and after the 12th day appear to correspond to cells treated as spermatogonia.
- 1122 Sävghen, R. THE EFFECT OF OXYGEN CONCENTRATION ON THE FREQUENCY OF INDUCED XO MALES AND NON-DISJUNCTION FEMALES AFTER IRRADIATION OF Drosophila MALES. Hereditas 47 (1961) 163-89.

Studies were made on the effect of irradiation under different oxygen concentrations during various stages of spermatogenesis. Drosophila, 0-1 and 3-4 d old y^{16} and sc^8Y males, were irradiated in commercial nitrogen or oxygen and mated to virgin y w sn females. A comparison between the yield of XO males after irradiation under anaerobic conditions and the corresponding data after treatment in air shows that a significantly lower rate of induced XO males is obtained after irradiation in N_2 atmosphere. The difference is most marked in mating periods corresponding to the period of highest sensitivity. The effect of commercial oxygen on the frequency of induced XO males after irradiation of 0-1 and 3-4 d old males is reversed as compared to the effect of air atmosphere. For 3-4 d old males irradiation in O_2 increases the yield of XO males. For both types of males almost no enhancing effect is obtained for mature spermatozoa after irradiation in O_2 . It is concluded that it is not possible to talk about a common air/nitrogen ratio of radiosensitivity for irradiated Drosophila males, since there exists great variations between the different mating periods. For 3-4 d old males, irradiation under anoxia gives an almost total protection against induced non-disjunction. For 0-1 d old males a reduction in the yield of non-disjunction females is observed. The relation between radiosensitivity and intra and/or intercellular oxygen available in the treated cells is discussed. (From auth. summary)
- 1123 Schmid, W. THE EFFECT OF CARBON MONOXIDE AS A RESPIRATORY INHIBITOR ON THE PRODUCTION OF DOMINANT LETHAL MUTATIONS BY X-RAYS IN Drosophila. Genetics 46 (1961) 683-70.

Dominant lethal damage in immature germ cells of Drosophila virilis, obtained by x-radiation in CO, is drastically enhanced by the presence of very small amounts of oxygen. These small amounts of O₂ which would easily be removed by cellular respiration get access to the vicinity of the chromosomes if respiration in the cytoplasm is blocked. Post-treatment with CO + 5% O₂ for 9 h in the dark with the flies immobilized by the CO showed no effect on the x-ray-induced dominant lethal rate obtained from mature and immature stages of male germ cells. (Auth.)

- 1124 Seecof, R.L. TREATMENT OF EGGS FROM CARBON DIOXIDE SENSITIVE Drosophila WITH X-RAYS AND ULTRAVIOLET RADIATION. (Abstr.) Genetics 47, 8 (1962) 983.

Eggs were collected from females of a stabilized, CO₂-sensitive strain of Drosophila melanogaster, irradiated with x-rays or ultraviolet light, and permitted to develop into adult flies. The titer of the virus-like factor (sigma factor) causing the sensitivity was measured in these adults and compared to the titer in adults that developed from untreated eggs. Ultraviolet radiation from a germicidal lamp in doses of 200-800 ergs/mm² (mortality 15-40%) caused 4-8-fold increases in titer. Higher doses were not effective in raising titers. X-ray treatments in a range giving 20-70% mortality failed to cause measurable changes in titer. The titer increases following ultraviolet light treatment were significant in all of the 3 experiments done to date, but more elaborate control experiments are needed to establish the effect. Experiments are now being done to confirm the titer increases and to determine whether the titer increases represent an induction of infectious sigma from a noninfectious stage in the sigma life cycle.

- 1125 Shiomi, R., Tachibana, H. PROTECTIVE ACTION OF PENICILLIN AGAINST MUTAGENIC EFFECT OF X-RAYS IN Drosophila. (Abstr.) Jap. J. Genet. 37 (1962) 411-2. (In Japanese.)

- 1126 Shiomi, T. EFFECT OF PENICILLIN FEEDING ON THE REDUCTION OF RADIATION INDUCED MUTATION RATE IN Drosophila melanogaster. (Abstr. 5.46) p.71 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

A wild type D. melanogaster, Canton-S, was grown in a culture medium containing penicillin G (20 000 units per ml); 24 h old virgin males hatching from these cultures were irradiated with x-rays. The induced sex-linked recessive lethal mutations in mature sperms were tested by the Muller-5 method. X-ray doses used were 500, 1000, 2000, and 3000 r. The radiation induced mutation rates in penicillin-fed Drosophila are found to be about 1/2 of those for flies grown in normal culture conditions. The radiation dose-effect relationship remains linear. Penicillin containing medium lengthens the growth period of flies by nearly 1 d as compared to the normal culture, and the rate of emergence is higher than in the control. The feeding of penicillin during the first half of the larval stage is more effective in reducing the induced mutation rate than when fed during the 2nd half. The interpretation of this action of penicillin on the radiation induced mutations, especially its effect in the early stage of feeding, is difficult. (From abstr.)

- 1127 Sobels, F.H., Bates, A.D. RECOVERY FROM PREMUTATIONAL DAMAGE OF X-IRRADIATION IN Drosophila SPERMATOGENESIS. J. cell. comp. Physiol., 3 Suppl. 1 58 (1961) 189-96.

Data relating to repair processes in Drosophila males are summarized. The data suggest that repair from premutational damage is possible in at least 3 different stages of spermatogenesis, that is spermatids, meiotic stages, and late spermatogonia. Most data are available for stages characterized by peak sensitivity to x-irradiation, presumably consisting of spermatids and late spermatocytes. Here fractionation of the dose and pre-treatment with chloramphenicol lower the mutagenic effects of radiation, whereas post-treatment with N₂ results in an increase of radiation-mutagenicity. Post-treatment with cyanide may result in either an increase or a decrease of the mutation-frequency. As pointed out before, these observations can be explained by assuming that two processes with contrasting effects are involved in repair from premutational damage. Recovery seems to occur in dividing cells as meiotic stages and late spermatogonia where the mutagenic effect of radiation is reduced by pre-treatment with chloramphenicol and enhanced by anoxia, following radiation. In view of the present Drosophila data and other studies elsewhere the author considers the possibility of a uniform pattern to which repair-processes conform in dividing cells of widely divergent organisms. (From auth.)

- 1128 Sobels, F.H. THE ROLE OF OXYGEN IN RADIOSENSITIZATION BY CYANIDE IN Drosophila. Int. J. Rad. Biol. 3, 3 (1961) 328-9.

Male flies were pre-treated with HCN in O₂ or N₂ and irradiated in the respective gases. Sex-linked lethal tests were made for successive broods. Results in O₂ and in purified N₂ at low doses (590 r/min of

x-rays) suggest that accumulation of O_2 plays a part in the enhancing effect of cyanide in spermatids after irradiation in air. The findings in impure and purified N_2 show that in the presence of a respiratory inhibitor even small amounts of O_2 may lead to a drastic increase in radiosensitivity. The fact that cyanide pre-treatment is effective in purified N_2 after high-intensity (2640 r/min) but not after low-intensity radiation is considered as an indication of a dose-rate effect specifically connected with cyanide pre- or post-treatment.

- 1129 Sobels, F.H. MODIFICATIONS OF THE MUTAGENIC EFFECT OF X-IRRADIATION IN *Drosophila* MALES BY CHLORAMPHENICOL AND RIBONUCLEASE. (Abstr.) p.121 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

It had been inferred that inhibition of protein synthesis favours repair of pre-mutational radiation damage (See 1131). This assumption is supported by the observation that both pre-treatment with ribonuclease, known for its inhibiting effect on protein synthesis, and post-treatment with chloramphenicol reduce the mutation frequency in comparison to that produced by x-irradiation alone. To explain the results it has been assumed that, from a certain amount of pre-mutational damage, a proportion does not result in mutation and that this repair process is restricted to a definite time-interval following exposure to radiation. The action of chloramphenicol and ribonuclease is thought to consist then in protracting the time-span available for repair of pre-mutational damage, which would result in a lowering of the mutation frequency. Further data relating to this interpretation will be reported. For all experiments, males carrying a closed-X chromosome were used. This restricts the genetic effects observed to point-mutational lethals and possibly small deletions.

- 1130 Sobels, F.H. DOSE RATE, CYANIDE, AND SOME OTHER FACTORS INFLUENCING REPAIR OF MUTATIONAL RADIATION DAMAGE IN *Drosophila*. Abh. dtsh. Akad. Wiss., Berl. Kl. Med. (1962) 115-30.

In irradiated *Drosophila* spermatids and spermatocytes, repair processes were shown to occur in flies by treatment with cyanide. In the germ cell stages showing peak sensitivity to radiation, post-treatment with cyanide resulted in a significant increase of the mutation frequency, if x-irradiation was given at a high dose rate of 2200 r/min. Post-treatment following radiation at lower dose rates of 600 r/min or 150 r/min, however, did not notably change the frequency of mutation. Evidence was obtained that the increase in lethal frequency due to cyanide involves gene mutations and possibly small deletions. Cyanide may also inhibit a system responsible for repair of part of the pre-mutational radiation damage, and it was shown that cyanide can produce both enhancement and lowering of the mutation frequency induced by high-intensity radiation in spermatids. Pre-treatment experiments under conditions (N_2 or O_2), where cyanide is ineffective, if preceding low-intensity radiation, suggest that there is a specific dose rate dependence in the presence of cyanide. It was assumed that in the presence of cyanide high-intensity radiation, apart from direct damage to the chromosomes, affects a second susceptible system, which may be associated with repair processes. Other observations on modification of radioinduced frequencies after dose fractionation, post-treatment with N_2 , and pre-treatment with both chloramphenicol and ribonuclease are reported. (NSA 17:1963, 24901)

- 1131 Sobels, F.H. MODIFICATION OF PRE-MUTATIONAL RADIATION DAMAGE IN *Drosophila*. p.197-212 in "Strahlenwirkung und Milieu (Radiation Effect and Milieu). Internationales Radiobiologisches Symposium in Montreux vom 28. Mai-3. Juni 1961". Sonderbände zur Strahlentherapie. Band 51. Fritz-Niggli, H., Ed. München, Urban & Schwarzenberg. 1962.

Changes of radiation-induced mutation frequencies in successive stages of spermatogenesis are reported after post-treatment with both HCN and N_2 , after dose-fractionation and after pre-treatment with both chloramphenicol and ribonuclease. Except for the experiments with chloramphenicol and ribonuclease all exposures were given at a high dose rate of 45 r or 55 r/sec. Post-treatment with cyanide may lead to either an increase or a decrease of the mutation rate in stages with peak sensitivity. Post-treatment with purified N_2 increases the mutation frequency in spermatids, meiotic stages and spermatogonia (the last non-reproducible). Fractionation of the dose lowers the mutagenic effect of radiation in stages with peak sensitivity. Dose-fractionation followed by post-treatment with N_2 reduces the mutation frequency in spermatogonia. Pre-treatment with chloramphenicol decreases the mutation frequency in spermatids, spermatocytes and late spermatogonia, whereas an increase was observed in mature sperm. Pre-treatment with ribonuclease raises the mutation frequency in mature sperm and lowers it in spermatids. Modification of pre-mutational damage in *Drosophila* males is concluded to be possible in spermatids, meiotic stages and perhaps in spermatogonia. Two contrasting processes are postulated. The observations after pre-treatment with chloramphenicol and ribonuclease in sperm and spermatids suggest that protein synthesis is involved in the different radiosensitivities of these two stages. (From auth. summary)

- 1132 Sobels, F.H. RECOVERY FROM GENETIC RADIATION DAMAGE IN Drosophila. T.N.O.-Nieuws 17, 200 (1962) 574-7. (In Dutch).
- 1133 Sobels, F.H., Bates, A.D. EXPERIMENTS ON REPAIR OF PRE-MUTATIONAL RADIATION DAMAGE IN Drosophila. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 379.

Males carrying a ring-shaped X-chromosome (XC^{2y8}) were used throughout. This restricts the genetic effects observed to lethal point mutations and possibly small deletions. In one of the post-treatment experiments a reduction of the radiation-induced mutation-frequency due to chloramphenicol was observed throughout all stages, in another only in spermatogonia. In experiments on the effect of pre-treatment with ribonuclease, a significant decrease of the mutation-frequency was repeatedly observed in spermatids. The similarity in effect of ribonuclease with that of chloramphenicol suggests that inhibition of protein-synthesis can be held responsible for the reduction of the mutation-frequency, following pre-treatment with these substances. When the experiments on post-treatment with N_2 were continued, an increase of the mutation-frequency in spermatids of the post-treated group was consistently observed. A treatment-dealy experiment showed that the critical time-span during which modification of the mutation-process by N_2 is still possible, does not exceed 25 min. It has been assumed that from a certain amount of pre-mutational radiation damage, a proportion does not result in mutation and that this repair process is restricted to a definite time-interval. The increase of the mutation-frequency after post-treatment with N_2 is thought to result from an inhibition of the metabolic repair process. To explain the reduction of the mutation-frequency due to both pre- or post-treatment with chloramphenicol and pre-treatment with ribonuclease, it is assumed that inhibition of protein-synthesis increases the time-span available for repair of pre-mutational radiation damage. (From abstr.)

- 1134 Sobels, F.H. THE CONTRASTING EFFECTS OF OXYGEN AND NITROGEN IN DETERMINING INITIAL SENSITIVITY AND POST-RADIATION RECOVERY IN Drosophila SPERM AND SPERMATIDS. Int. J. Rad. Biol. 7, 5 (1963) 505.

Irradiation in O greatly restricts the capacity of the sperm or spermatids of Drosophila to undergo repair, as compared with irradiation in N. The O/N enhancement factor for irradiation-induced mutations was 1.3 for sperm and 3 for spermatids. (CA 61:1964, 7325 p-7326 a)

- 1135 Sobels, F.H. PEROXIDES AND THE INDUCTION OF MUTATIONS BY X-RAYS, ULTRAVIOLET, AND FORMALDEHYDE. Rad. Res., Suppl. 3 (1963) 171-83.

Results are reviewed from studies on the role of peroxides in the induction of mutations in Drosophila by x-rays, ultraviolet radiation, and formaldehyde. It is highly probable that the formation of either an organic peroxide or of free radicals including peroxidic and peracid radicals are involved in the production of mutations by formaldehyde and also perhaps in the radiosensitizing effect exerted by formaldehyde. This, then, seems at present the only possible experimental evidence that peroxides may be involved in the production of mutations by x-irradiation in Drosophila.

- 1136 Sobels, F.H. REPAIR AND DIFFERENTIAL RADIOSENSITIVITY IN DEVELOPING GERM CELLS OF Drosophila MALES. p.179-97 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Pre-treatment of Drosophila germ cells with either chloramphenicol or ribonuclease was found to decrease the radioinduced frequencies of sex-linked lethals (XC^{2y8} chromosome) in stages showing peak sensitivity to x-irradiation, corresponding to spermatids and late spermatocytes. In mature sperm these agents cause a significant increase of the mutation frequency. The results with spermatids suggest that inhibition of protein synthesis lowers the initial sensitivity to the induction of pre-mutational damage. Post-treatment with O_2 , following radiation exposure to 3000 r in N_2 , lowers the mutation-frequency. It is thought that, under these conditions, O_2 acts by activating an inhibited repair system. After exposure to 1000 r in O_2 , the effect of post-treatment with O_2 exactly equalled that of post-treatment with N_2 . This finding is interpreted on the assumption that the biochemical system responsible for repair, is damaged to a greater extent by irradiation in O_2 than in N_2 . The observation that after exposure of a ring-X chromosome there is a dose rate dependence in the presence of cyanide and that dose fractionation produces fewer mutations in spermatids than unfractionated radiation, support the idea that the repair system itself is liable to undergo radiation damage. Post-treatment with chloramphenicol produced an enhancement of the mutation frequency in two experiments; so did streptomycin. These findings are taken as an indication that protein synthesis is required for the repair process. In other experiments, however, post-treatment with chloramphenicol lowered the mutation frequency. It was concluded that the mutational response in

Drosophila spermatids can be resolved into four components, which can be modified separately: initial radiosensitivity to the induction of pre-mutational damage, efficiency of the repair process, time of mutation fixation, radiation damage to the repair system. (NSA 18: 1964, 11887)

- 1137 Steger, J. M. EFFECT OF 2, 4-DINITROPHENOL ON IRRADIATION-INDUCED DOMINANT LETHALS FACTORS IN Drosophila melanogaster. Oncologia 15 (1962) 247-57.

The influence of 2, 4-dinitrophenol (I) on the radiation-induced rate of the dominant lethal factors of D. melanogaster was investigated. 72- and 96-h Larvae, whose testicles contain mainly spermatocytes, were given 1000 r of a 180 kv, 6 mA radiation. The descendants of irradiated males with non-irradiated females were examined regarding dominant lethal factors. The rate of dominant lethal factors was lowered by I from 82 to 71-8%, according to the I dose given before radiation. The protective effect of I could be due to a variety of intracellular processes, which have a partly mutation-stimulating, partly mutation-preventing effect. Of all factors, the hypoxia of the spermatocytes, caused by I during the irradiation, seems to have the largest effect. (CA 58: 1963, 4851h)

- 1138 Sumarukov, G. V. CORRELATION BETWEEN THE REDOX POTENTIAL OF THE LYMPH OF CRICKETS DURING IRRADIATION AND RADIOSENSITIVITY. (Abstr.) p. 95 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

A micromethod has been developed to determine the redox potential of the haemolymph of insects in vivo. The effect of various protective factors (hypoxia, protective substances) which influence the radiosensitivity of insects has been investigated. Uncorrelated differences in the values of the redox potential have been observed for solutions of protective substances and for tissues into which protective substances had been introduced. On the other hand, when protective substances are introduced into the organism during hypoxia, the values of the redox potential exactly correlate with the magnitude of the protective effect and radiosensitivity. The data reported in the literature which failed to show such correlation were obtained when the potential was measured in vitro and did not allow for the redistribution of the rates of oxidation-reduction reactions in living systems, altered by the protective effects.

- 1139 Сумаруков, Г. В. КОРРЕЛЯЦИЯ МЕЖДУ ВЕЛИЧИНОЙ ОКИСЛИТЕЛЬНО-ВОССТАНОВИТЕЛЬНОГО ПОТЕНЦИАЛА ГЕМОЛИМФЫ СВЕРЧКОВ И ИХ РАДИОЧУВСТВИТЕЛЬНОСТЬЮ. Радиобиология 2, 3 (1962) 374-7.

Sumarukov, G. V. CORRELATION BETWEEN THE VALUE OF THE OXIDATION-REDUCTION POTENTIAL OF THE HAEMOLYMPH OF CRICKETS AND THEIR RADIOSENSITIVITY. Radiobiology 2, 3 (1962) 58-62. Translation from Radiobiologiya 2, 3 (1962) 374-7.

It could be demonstrated that when crickets (Gryllus domesticus L.) were subjected to γ -radiation, cysteine and hypoxia had a cumulative protective effect. (Air was replaced by N_2 at the time of irradiation). The following LD_{50} -values were obtained: without protection - 4200 r; with free cysteine - 6750 r; with hypoxia - 9900 r; with cysteine and hypoxia - 11900 r. A direct relationship was established between the in vivo value of the oxidation-reduction potential of cricket haemolymph and cricket radiosensitivity. A correlation was observed within the Eh range from +140 mV in unprotected crickets to -185 mV in crickets in N_2 after previous cysteine-injection. The relationship between radiosensitivity and the value of the oxidation-reduction potential of the tissues at the time of irradiation may be explained by the competition of various reducing agents (their concentration having increased under the influence of the protective factors) with the vitally important cellular reducing agents for oxidizing radicals and peroxides arising from irradiation.

- 1140 Bates, A. D., Sobela, F. H. THE GENETIC EFFECTS OF POST-RADIATION TREATMENT WITH CYANIDE IN PUPAL SPERMATIDS. Drosophila Inf. Serv. 35 (1961) 98-99.

- 1141 Bates, A. D., Sobela, F. H. MODIFICATION OF GENETIC RADIATION DAMAGE IN Drosophila BY POST-TREATMENT WITH NITROGEN AND FRACTIONATION OF THE DOSE. Int. J. Rad. Biol. 3, 5 (1961) 553-4.

Male flies with ring-shaped X-chromosome were exposed to a flow of purified N_2 during 25 min, following 1450 r (at 55 r/sec) of x-rays. Tests for sex-linked lethals were made in 5 successive 2-d broods, using 3 females/male/brood. In 2 independent experiments, a significant increase in the mutation frequency due to post-treatment was observed in the last 3 broods, representing stages with peak sensitivity and

earlier stages (8.7% lethals in 3857 chromosomes after radiation alone, and 9.05% lethals in 3920 chromosomes in the post-treatment group, $\chi^2 = 13.29$). The effect of dose fraction was studied in 5 exposures, separated by 2 h of 1350 r (at 45 or 55 r/sec). In 2 out of 3 experiments, the mutation frequencies in stages with peak sensitivity were significantly ($\chi^2 = 11.04$) lower in the fractionated group (7.2% lethals in 2694 chromosomes) than in flies after unfractionated dose (9.8% for 2585). No such effects were seen in mature sperm and spermatogonia. With N_2 post-treatment, dose fractionation also resulted in a significant decrease in mutation frequency (9.9% lethals in 2020 chromosomes for group in N_2 , after unfractionated exposure, against 8.0% in 2878 when 5 fractions were used; $\chi^2 = 7.88$). Repair of pre-mutational damage appears possible at peak sensitivity stages (presumably spermatids and late spermatocytes); fractionation lowers the mutagenic effects of high-intensity radiation, while post-treatment with N_2 , like that with HCN (earlier) results in an increase of the radiation-induced mutation frequencies.

- 1142 **Tates, A.D.** MODIFICATION OF THE X-RAY INDUCED RATE OF SEX-LINKED LETHALS BY NITROGEN POST-TREATMENT AND FRACTIONATION OF THE DOSE IN *Drosophila melanogaster*. (Abstr. 5, 44) p. 70 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

Results of 5 independent experiments* show a significant increase of mutation frequency due to post-treatment in spermatids and late spermatocytes, 9.8% lethals (3744 tested chromosomes) were found after irradiation without post-treatment and 10.8% lethals (5190 chromosomes) with N_2 post-treatment; normal deviate = 2.21 and $P = 0.0139$. A possible interpretation of the results is that N_2 post-treatment blocks repair of pre-mutational damage. In 2 experiments a 3rd group of flies received N_2 post-treatment after a delay of 25 min. A comparison of the results of delayed versus direct post-treatment shows a significant decrease of the mutation rate in the group with delayed post-treatment. The percentage for the direct treatment is 9.54% (2222 chromosomes) and for the delayed treatment 7.16% (2645 chromosomes); normal deviate 2.538 and $P = 0.0055$. This result suggests that in young spermatids and late spermatocytes repair, under these experimental conditions, is completed within 25 min. Five experiments were carried out to investigate whether dose fractionation favours repair. The mutagenic effects of a dose of 1350 r given in five equal fractions, separated by two hour-intervals, were compared with that of unfractionated irradiation. The results show a significant decrease of mutation frequency due to fractionation, in the same germ cell stages where N_2 -post-treatment had been effective. Percentages of lethals for the fractionated and unfractionated groups are 8.63% (4994 chromosomes) and 9.77% (4676 chromosomes) respectively (normal deviate 3.01 and $P = 0.0013$).

*[see 1141]

- 1143 **Tazima, Y., Kondo, S., Sado, T.** TWO TYPES OF DOSE-RATE DEPENDENCE ON RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. *Genetics* 46 (1961) 1335-45.

Dose-rate dependence of radiation-induced mutation rate was studied in silk-work spermatogonia and oögonia by the use of the specific locus method. Both sexes of a wild-type strain were exposed to x-rays, Cs^{137} γ -rays of high dose rate, or to Co^{60} γ -rays of low dose rate at a definite stage or during a definite period in early larval stages. The dose-rate ratios between the acute and chronic irradiations were 2500:1; 1 to 7600:1. The total doses given were 950 r or 1000 r. Two types of dose-rate dependence of radiation-induced mutation rate were found. In one type mutagenic effectiveness of chronic irradiation is lower than that of acute irradiation (Type I) and in the other mutagenic effectiveness is higher in chronic irradiation than acute irradiation (Type II). The former is observed only in the very young larval stage when the primordial germ cells are prevalent in the testis, while the latter is found when later stages of spermatogonia or oögonia are irradiated. For Type I dose-rate dependence, repair of primary mutations seems to be responsible, whereas for Type II dose-rate dependence selective killing of a specific type of cells by intense exposure seems to play an important role. The relationship between our finding and that of Russell is discussed. Radiation-induced mutation frequency is remarkably high at the very early stage of larva, i. e., around the time of hatching when the primordial germ cells are prevalent in the gonads. (Auth.)

- 1144 **Tazima, Y., Kondo, S.** DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES AND SELECTIVE KILLING. (Abstr.) *Jap. J. Genet.* 36 (1961) 395. (In Japanese).

- 1145 **Tazima, Y., Kondo, S.** FURTHER STUDIES ON TWO TYPES OF DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. *Annu. Rep. nat. Inst. Genet., Mishima* 1961 12 (1962) 86-7.

- 1146 Tazima, Y., Kobayashi, T. COMPARISON OF ACUTE AND CHRONIC IRRADIATIONS IN RESPECT TO RADIATION-INDUCED LETHAL MUTATION RATES IN THE SILKWORM. Annu. Rep. nat. Inst. Genet., Mishima 1961 12 (1962) 87-90.
- 1147 Tazima, Y., Kondo, S. FURTHER STUDIES ON DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. (Abstr.) Jap. J. Genet. 37 (1962) 414. (In Japanese).
- 1148 Tazima, Y., Kondo, S., Sado, T. STUDIES ON THE GENETIC EFFECT OF RADIATION 1959-1960. II. STUDIES ON THE GENETIC EFFECT OF RADIATION WITH SILKWORM. (2) TWO TYPES OF DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATE IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. Nucl. Sci. Abstr., Japan 1, 3/4 (1962) 118. (In English).
- See 1143

- 1149 Tazima, Y., Kondo, S. FURTHER STUDIES ON TWO TYPES OF DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. p. 7 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Two types of dose-rate dependence of radiation-induced mutation frequency have been found in early gonial cells of silkworm. In one type mutagenic effectiveness of chronic irradiation is lower than that of acute irradiation, and in the other the situation is completely reversed. The occurrence of either type depends upon the stage of germ cells. These findings have been interpreted by assuming differential repair for the former and selective killing for the latter (see 1143).

Further evidence compatible with the hypothesis of selective killing will be presented. Variation in induced mutation frequency was studied along with the development of germ cells both for the acute and chronic irradiation. It varied drastically after acute irradiation, being highest at the time of hatching and decreasing rapidly toward later stages, while it was almost constant after the chronic irradiation. Irradiation with various dose-rates in later stages revealed that the mutagenic effectiveness of radiation decreases gradually with increase in dose-rate within the range from 0.14 r/min to 320 r/min. In this stage mutation frequency for the acute did not deviate even at 150 r from a linear relation extrapolated from higher doses, suggesting that the delivered dose was too high to realize the expectation that a small dose of acute irradiation might give a higher frequency than expected from linear relation. Although directly supporting evidence is still meagre, there are two distinct types of dose-rate dependence, one of which cannot be interpreted by the repair hypothesis.

- 1150 Traut, H. DOSE-DEPENDENCE OF RADIATION-INDUCED MUTATION RATE IN Drosophila melanogaster DEPENDING ON THE STAGE SENSITIVITY OF THE IRRADIATED GERM CELLS. (Abstr.) p. 199 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Dose and stage dependence of radiation-induced mutation rate were investigated. Utilizing the dual-purpose strain constructed by Oster (1958) the dose-dependence of the frequency of x-ray-induced sex-linked lethals and II/III-translocations for several succeeding 1-d broods were studied, using 10 or 5 P-females per male, and irradiating 3-4-d-old Bar males (7 doses). With the co-operation of W. Ebeling, 174-h-old male pupae were also irradiated (5 doses). In addition, the dose dependence of lethals and translocations after irradiation of spermatozoa stored in inseminated females (9 doses) as well as of radiation-induced chromosome loss after irradiation of mature oöcytes (11 doses) were investigated. A stepwise increase of mutation rate with dose for almost all our dose-effect curves was found. For sex-linked lethals dose exponents > 1 for restricted dose regions were obtained. These results are discussed in relation to the following theoretical suppositions: approximation of a definite n-hit function by biological variability concerning hit number and formal target volume; 'mutation-by-breakage' hypothesis; and 'position-effect' hypothesis. Special attention is paid to the departures (most of which are statistically significant) from the "classic" one-hit relation for sex-linked lethals. (From abstr.)

- 1151 Traut, H. DIE DOSISABHÄNGIGKEIT DER STRAHLENINDUZIERTEN MUTATIONSRATE BEI BERÜCKSICHTIGUNG DES REIFEGRADES DER KEIMZELLEN, UNTERSUCHT AN Drosophila melanogaster. (A study of dose-dependence of radiation-induced mutation rates in Drosophila melanogaster, allowing for the degree of maturity of the germ cells.) Thesis. Heidelberg, Germany. Universität, 1962 (In German).

- 1152 Traut, H. DOSE DEPENDENCE OF THE FREQUENCY OF RADIATION INDUCED RECESSIVE SEX-LINKED LETHALS IN Drosophila melanogaster. (Abstr.) Int. J. Rad. Biol. **6**, 4 (1963) 377.
- Using the dual-purpose strain constructed by Oster, the dose-dependence of sex-linked lethals and translocations for the first 4 one-day-broods after irradiating 3-4 d old Bar-males was studied. Only the results on lethals are reported here. The ratio P-females: P-males was 10:1 or 5:1. Different doses of radiation were given from 1000 to 6000 r, using filtered x-rays at 150 kV. The lethal-curves are characterized (1) by dose-exponents >1 restricted to certain dose-regions, (2) by a step-wise increase of lethal rate with dose. Most of the departures from linearity thus obtained are statistically significant. The same is true for the results obtained by irradiating maximal sensitive germ-cells in male D. melanogaster-pupae, using low radiation doses, by Ebeling and Traut. (From abstr.) See also 1153.
- 1153 Traut, H. DOSE-DEPENDENCE OF THE FREQUENCY OF RADIATION-INDUCED RECESSIVE SEX-LINKED LETHALS IN Drosophila melanogaster, WITH SPECIAL CONSIDERATION OF THE STAGE SENSITIVITY OF THE IRRADIATED GERM CELLS. p.359-74 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press, 1963.
- In experiments showing a linear dose-effect relationship for sex-linked recessive lethals in Drosophila males, insufficient consideration has been given hitherto to the dependence of radiation sensitivity on cell stage. The effect of radiation dose on mutation frequency was subjected to a renewed study with emphasis on differential radiosensitivity. The following results were obtained: dose-exponents significantly greater than one for certain dose-ranges, indication of a stepwise increase of lethal rate with dose. Most of the departures from linearity thus obtained are statistically significant. Results are discussed in relation to the mutation by-breakage hypothesis and the problem of position-effect lethals. They seem to confirm Muller's suggestion that at relatively high doses, the linearity of the classical dose-effect curve for recessive sex-linked lethals is caused more or less incidentally by the counteraction of different factors. Furthermore, our findings support the calculations by Zimmer (1960) and Dittrich (1960) showing that curves of the one-hit type may not necessarily be the result of one-hit events alone, but also, of the biological variability of the irradiated material with respect to hit number and formal target volume. (Auth.)
- 1154* Ulrich, H. DIE BEZIEHUNG ZWISCHEN STRAHLENDOSIS UND MUTATIONSRATE BEI RÖNTGEN-BESTRAHLUNG VON Drosophila-ZYGOTEN. (The relationship between dosage and mutation rate in x-radiation of Drosophila zygotes). Rev. suisse Zool. **67** (1960) 287-95. (In German).
- Zygotes (wild (females) X Muller 5 (males) were exposed to 200-1400 r. The reduction in number of males of the offspring of the radiated generation was taken as a measure of the rate of mutation in the Muller 5 X-chromosome to form a lethal recessive factor. The thus measured rate of mutation shows a linear relationship to dosage only if care is taken to maintain an optimum density of larvae in the culture tubes. Poor conditions resulting from under or overpopulation select against the larvae that are heterozygous for the lethal mutation, so that the measured mutation rate is less than the induced mutation rate. The possibility of such selection effects should be considered in all such mutation-rate experiments. (BA 36: 1961, 32829)
- 1155 Ulrich, H., Würgler, F.E. OXYGEN EFFECT IN NEWLY LAID Drosophila EGGS. (Abstr.) p.187 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.
- Eggs 15 ± 5 min after deposition were x-rayed. It has been shown that O₂ can be removed from such eggs within seconds by a N₂-current. Only a slightly greater number of eggs die during embryogenesis when treated for 7 min with a N₂-current, as compared with air-treated controls. It is therefore possible to analyze the O₂ effect with very short pre-treatment time and no lethal effects of anoxia. For the embryonic mortality and mutation rate (recessive lethals in the X-chromosome) the O₂ enhancement ratio was found to be between 2.0 and 2.5. Improvements in the egg-collecting procedure have made it possible to collect egg samples which are more homogeneous in age and thus in division stages. With these samples, of age variation of ± 1.5 min, the O₂ effect in relation to different division stages is being studied again. (From abstr.)
- 1156 Ulrich, H. PARTIAL IRRADIATION OF Drosophila ZYGOTES BY X-RAYS. (Abstr.) Int. J. Rad. Biol. **6**, 4 (1963) 381.
- Fertilized eggs of D. melanogaster were x-irradiated totally 10-20 min after being laid, i.e. in different developmental stages before cleavage. Embryonic mortality as well as the rate of recessive lethal mu-

rations in the X-chromosome (determined by testing the surviving female adults by a special Muller 5 technique) increases linearly with dose. The same is true when the uncleaved zygotes are irradiated in a N-current instead of air, when the N-values with all doses are only $\sim \frac{1}{2}$ those for air. Eggs were also irradiated such that either the nucleus (the two pronuclei) in different division stages together with approximately the anterior half of the cytoplasm, or the posterior half of the cytoplasm without any nucleus, were treated. The effects of anterior-half irradiation are mainly the same as those of total treatment. Compared with these, the effects of posterior-half irradiation differ quantitatively and qualitatively. For instance, the dose-mortality curves differ in slope and shape. These and other differences demonstrate a much higher radiosensitivity and, thus, a much greater importance of the nucleus than of the cytoplasm in the killing effect of x-rays. Moreover, the differences indicate the existence of a specific x-ray effect on the cytoplasm. This effect cannot be detected in cases of total or anterior-half irradiation, since doses which would cause cytoplasmic damage would be considerably greater than the lethal dose for direct irradiation of the nucleus. However, in case of posterior-half irradiation with quite high doses, the cytoplasmic effect appears, but apparently together with other effects. After irradiation of the posterior half the embryonic mortality, for instance, could be due not only to a lethal effect on the cytoplasm itself, but also to scattered radiation energy reaching and damaging the shielded nucleus, and/or to an effect exerted on the nucleus by the irradiated cytoplasm (indirect radiation effect). The origin of sex-linked recessive lethals found after irradiation not only of total eggs or their anterior halves (direct irradiation of nucleus), but also of posterior halves (irradiation of cytoplasm only) are being investigated. (From abstr.)

- 1157 * Ursprung, H. FRAGMENTIERUNGS- UND BESTRAHLUNGSVERSUCHE ZUR BESTIMMUNG VON DETERMINATIONSZUSTAND UND ANLAGEPLAN DER GENITALSCHEIBEN VON Drosophila melanogaster. (Experiments in fragmentation and irradiation for the assessment of the state of determination and the anlage pattern of the genital discs of Drosophila melanogaster). (TID-3098, no. 4209). Roux Arch. EntwMech. Organ 154, 4 (1959) 504-58. (In German).

- 1158 Vatti, K. V. A STUDY OF THE SUCCESSIVE EFFECT OF ROENTGEN RAYS AND TEMPERATURE UPON THE FREQUENCY OF MUTATIONS AND ROENTGENOMORPHOSES. p.189-93 in "Pervichnye Mekhanizmy Biologicheskogo Deistviya Ioniziruyushchikh Izlucheniĭ". Moscow, Publishing House of the Academy of Sciences, 1963. (In Russian).

Experimental evidence is brought forward on the successive effect of roentgen rays and temperature upon the mutation and morphoses frequency in Drosophila. It was shown that additional treatment with high temperature results in a considerable increase of the mutation and morphoses frequency exceeding the sum of the effects of these factors individually. The question is discussed of the presence after irradiation in the immature germ and somatic cells of a reversible state of increased sensitivity (after-effect) so that weak additional treatment greatly enhances the genetic and biological effect of irradiation. (Auth.)

- 1159 Wedvik, H., Strømnaes, Ø. THE EFFECT OF TEMPERATURE DURING IRRADIATION ON THE BROOD-PATTERN OF DOMINANT LETHALS INDUCED IN Drosophila melanogaster SPERM. Int. J. Rad. Biol. 7, 4 (1963) 369-75.

Four sets of males were exposed for half an hour to either 22°C, 7°C, 4°C or 0°C and then mated to a new set of 5 virgin females on each day for 14 d. The first sterile males appeared on day 4 in the series exposed to 22°C or 7°C, and the number of sterile males increased at almost the same rate on later days in the two series. In the series exposed to 4°C and 0°C, the sterile males appeared already on the second day after exposure and increased on later days with a significantly higher rate than in the two previous series. The highest number of sterile males on each day is found in the series exposed to 0°C. Whether the males have been exposed to 22°C, 7°C, 4°C or 0°C does not seem to influence the fecundity of the fertile males, or the hatchability of eggs fertilized by sperm from these males. Males exposed to 7°C during irradiation with 1000 r of x-rays exhibit a significantly higher frequency of dominant lethals than males irradiated at 22°C for all broods from the 1st to the 7th after treatment, but the data for later broods indicate no difference between the two series. (Auth.)

- 1160 Wharton, D.R.A., Wharton, M.L. EFFECT OF β -MERCAPTOETHYLAMINE (MEA) ON THE RADIO-SENSITIVITY OF THE MALE COCKROACH, Periplaneta americana (L.). Rad. Res. 16 (1962) 723-7.

No increased resistance to radiation (10 000 rads) from a 2-MeV Van de Graaff accelerator was observed after the injection or ingestion of various toxic or non-toxic concentrations of MEA. Although the toxicity of ingested MEA attained a high level of lethality during several weeks of feeding, it was quickly lost on denial of MEA to the roaches. It is suggested that the dose of MEA that would be required to counteract the lethal dose of radiation would itself be too toxic to demonstrate protection.

- 1161 Whiting, A. R. TEMPERATURE EFFECTS ON LETHAL MUTATION RATES OF Habrobracon OOCYTES X-IRRADIATED IN FIRST MEIOTIC METAPHASE. Genetics 46 (1961) 811-8.
- Unmated females of Habrobracon were irradiated with 1263 and 1444 r at high and low temperature before, during, and/or after irradiation. A significant lowering of lethal changes induced in oocytes x-irradiated in first meiotic metaphase (LD 50 about 400 r) at low temperatures before and after exposure as measured by hatchability of unfertilized eggs was observed. Low temperature during irradiation (1½-2 min) did not significantly change survival rate although there is a suggestion of a tendency toward increased lethality. Theories are discussed as to the cause or causes of differential sensitivity of cells and the relation of the sensitivity to O₂ and temperature. (Auth.)
- 1162 Wind, H., Traut, H. ZUR SAUERSTOFFABHÄNGIGKEIT DER RATE STRAHLENINDUZIERTER CHROMOSOMENABERRATIONEN IN OÖZYTEN VON Drosophila melanogaster. (The influence of oxygen on the frequency of radiation-induced chromosome aberrations in oocytes of Drosophila melanogaster.) Z. VererbLehre 92 (1961) 34-7. (In German).
- Abrahamson's results concerning the influence of oxygen on the frequency of x-ray induced structural changes (half-translocations) in Drosophila oocytes were generally reproduced, especially the demonstration of a "reverse" oxygen effect (under special experimental conditions protecting action of O₂, sensitization by N₂). The added aberration frequencies of the 3rd and 4th day after the various treatments generally tended to decrease as compared with those of the first 2 days (dependence on state of maturity of the treated oocytes). Preirradiation treatment by N₂ increased the aberration frequency significantly. Possible explanations of this effect are discussed. (Auth.)
- 1163 Zakharov, I. A., Inge-Vechtomov, S. G. THE EFFECT OF ROENTGEN RAYS AND OF HIGH TEMPERATURE UPON THE CROSSING OVER PROCESS. p. 194-7 in "Pervichnye Mekhanizmy Biologicheskogo Del'sviya Ioniziruyushchikh Izlucheni". Moscow, Publishing House of the Academy of Sciences, 1963. (In Russian).
- A comparative study of the effect of x-rays and of high temperature upon the crossing-over frequency in the centromere region of chromosome III of Drosophila melanogaster females showed that these agents call forth crossing-over at different stages of oögenesis. High temperature proved to be a factor specific only to one stage, presumably the moment of chromosome conjugation (pro-phase of the first maturation division), whereas x-rays induce crossovers in cells both in the prophase of the first division and in the preceding stages. It is suggested that x-rays call forth some changes in the chromosomes of the oögonia that convert into chromosome exchanges when the cells reach the prophase stage of the maturation division. High temperature and x-rays act independently of one another. (Auth.)
- See also:
- 479 Cytogenetic studies of x-ray and ingested P³² induced sex-linked recessive lethals in Drosophila melanogaster. (Walen, 1962)
- 759 Ionizing radiations and the induction of chromosome mutations in the germ cells. (Ray-Chaudhuri, 1961)
- 757 Dependence of the frequency of occurrence of dominant lethal mutations in the spermatids of Drosophila upon dose of irradiation with fast neutrons. (Abeleva and Lapkin, 1963)
- 758 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. Progress Report, May 1, 1958-April 30, 1959. (Alexander, 1959)
- 759 Ibid. Progress Report, May 1, 1959-April 30, 1960. (Alexander, 1960)
- 760 Ibid. Progress Report, May 1, 1960-April 30, 1961. (Alexander, 1961)
- 767 Induction of nuclear damage by ionizing and ultra-violet radiation. (von Borstel, 1961)
- 768 A comparison of the susceptibility of the grain weevil (Sitophilus granarius L.) to accelerated electrons and ⁶⁰Co gamma radiation. (Bull et al., 1961)
- 776 The induction of dominant lethal mutations in x-irradiated Drosophila virilis oocytes. (Dickerman, 1962)
- 777 Induction of dominant lethal mutations in x-irradiated Drosophila virilis oocytes. (Dickerman, 1963)
- 785 The response of Drosophila testis to x-ray induction of dominant lethals. (Hoenigsberg et al., 1961)
- 787 Genetic and direct effects of gamma radiation on Drosophila. (Ives, 1963)
- 796 The effect of neutrons and x-rays on the fertility of Tribolium confusum. (McDonald, 1961)
- 803 Appearance of dominant lethal mutations in Drosophila melanogaster during cosmic flight on ship-satellite. (Parfenov, n.d.)
- 810 Action des rayons γ sur la stérilité d'une noctuelle du coton (genre Laphygma exigua). (Rasulov, 1963)

- 824 The role of recovery mechanism and oxygen effects upon changes in radiation sensitivity in sperm treated in mature males and fertilized females of Drosophila. (Alexander, 1962)
- 827 The effect of radiation dose rate upon the production of eye color mutations in the chalcid Dahlbominus. (Baldwin, 1961)
- 828 The effect of radiation dose rate on the production of eye colour mutations in the chalcid Dahlbominus. (Baldwin, 1961)
- 829 Dose rate effects on the yield of radiation-induced eye colour mutations in an insect. (Baldwin, 1963)
- 830 Radiobiologic studies with Drosophila. (Baxter, 1963)
- 841 The frequency-dose relation of x-ray-induced Y-suppressed lethals in Drosophila. (Edington et al., 1962)
- 854 The action of radiation and other mutagenic agents (1) in inducing mutation in Drosophila females, and (2) in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, 1961)
- 855 Ibid. Report Covering 9-Year Period, May 1, 1953-April 30, 1962. (Glass, 1962)
- 857 Effect of fractionation of the gamma-ray dose upon the frequency of occurrence of mutations in spermatids of Drosophila melanogaster. (Glumbotskif et al., 1961)
- 859 The effect of small doses of ionizing radiation on the frequency of occurrence of sex-linked, recessive, lethal mutations of Drosophila. (Glumbotskif et al., 1963)
- 863 Cytological effects of x-rays in relation to dose-rate in Drosophila melanogaster. (Gunson, 1962)
- 874 The influence of radiation in altering the incidence of mutations in Drosophila. (Indiana Univ. Foundation. Research Div., Bloomington, 1962)
- 880 Radiation induced viability mutations in the honey bee. (Lee, 1962)
- 895 Dose-rate and the induction of mutations in Drosophila. (Purdum and McSheehy, 1963)
- 918 Chromosome rearrangements induced by x-rays in immature germ cells of Drosophila. (Abrahamson, 1961)
- 950 Can Drosophila spermatozoa be used in studies of recovery processes? (Lüning, 1961)
- 962 Dose-effect relation in the induction of crossing-over with x-rays in males of Drosophila melanogaster. (Olivieri and Olivieri, 1963)
- 963 Induction of crossing-over in Drosophila melanogaster males with various doses and fractionated doses of x-rays. (Olivieri and Olivieri, 1963)
- 964 Induced crossing-over in males of D. melanogaster. (Olivieri and Olivieri, 1963)
- 967 The effect of accessory conditions on x-ray induced non-disjunction in Drosophila. (Oster and Pooley, 1963)
- 968 The genetic basis of somatic damage produced by radiation in third instar larvae of Drosophila melanogaster. (Ostertag, 1961)
- 970 Induction of chromosome aberrations in the spermatocytes of grasshoppers. (Ray-Chaudhuri, 1961)
- 979 The linear dose-dependence of radiation-induced translocation frequency in Drosophila melanogaster at relatively low x-radiation doses. (Traut, 1963)
- 990 The grasshopper neuroblast culture technique and its value in radiobiological studies. (Carlson, 1961)
- 1019 Cell stages and differential sensitivity to irradiation in males of Drosophila melanogaster. (Sävhaugen, 1963)
- 1020 Differential susceptibility of sperm and spermatids to ionizing radiations. (Schmid, 1961)
- 1025 Differential radiation-sensitivity of germ cells as a possible interpretation of sex difference in dose-rate dependence of induced mutation rates in the silkworm. (Tazima and Kondo, 1963)
- 1166 Recovery from radiation and chemically induced premutational damage. (Brink, 1962)
- 1181 Mechanism of resistance to virus diseases in the silkworm Bombyx mori (IV) (V) (VI). (Aruga, 1958)
- 1182 Studies on the induction of nuclear and cytoplasmic polyhedroses by treating with x-rays and ultra-violet light in the silkworm, Bombyx mori L. (Aruga and Yoshitake, 1961)
- 1183 15. Induction of virus infections. 2. Ultraviolet light and x rays. (Aruga, 1963)
- 1190 Radiation effects on the cytoplasm of Habrobracon eggs. (Kenworthy, 1962)
- 1205 The action of tumorigenic treatments and protective agents on melanotic tumour formation in D. melanogaster. (Burnet, 1963)
- 1222 Effects of radiations on insects. (LaChance, 1962)
- 1258 The effect of irradiation with γ -ray: Co^{60} on the development and reproductive power of Trombicula akamushi var. deliensis. (Hsu et al., 1963)
- 1271 The influence of age and mating patterns before and after irradiation on the incidence of induced mutations in Drosophila melanogaster. (Lefevre, 1963)
- 1273 Investigations of radiosensitivity during spermiogenesis in Drosophila melanogaster. (Mossige, 1963)

- 1277 Radiosensitivity of Drosophila spermatogonia. (Ofstedal, 1962)
- 1281 The effect of γ -rays on eggs of Ephesia kuehniella Zell. (Pelerents and Brande, 1961)
- 1325 The modification by x-irradiation of the life span of haploids and diploids of the wasp, Habrobracon sp. (Clark and Rubin, 1961)
- 1326 Life span differences between haploid and diploid males of Habrobracon serinopae after exposure as adults to x rays. (Clark et al., 1963)
- 1374 Reactions to X-rays of a normal and a HCN-unsusceptible stock of Drosophila melanogaster. (Liers, 1963)
- 1385 Research in genetics. (Stone, 1963)
- 1447 Laboratory studies on the use of irradiated sterile males to reduce C. fatigans Wied. populations. (Ramakrishnan et al., 1962)

I-A-7 RADIATION AND MUTAGENIC CHEMICALS: COMPARISON OF EFFECTS

- 1164* Bettendorf, G., Maass, H., Kirsten, E., Klinkel, H.A. THE EFFECTS OF X-RAYS AND CYTOSTATICS ON THE MUTATION RATE IN Drosophila. Strahlentherapie 112 (1960) 74-8 (In German).

By means of the combined application of ionizing rays and the chemical mutagenic substance 2, 5-bis(ethyleneiminobenzoquinone)-1, 4 (BBC) the degree of genetic effect on Drosophila was studied. The application of the mutagenic agents in the sequence of BBC + x-ray irradiation caused the addition of the different mutagenic effects, whereas the same treatment in the order of x-ray irradiation + BBC resulted in a considerably reduced yield of mutations. (Auth.)

- 1165 Borstel, R.C. von, Löbbecke, E.A. CELL KILLING AND THE PROBLEM OF NUCLEAR REACTIVATION. (Abstr.) p.240 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd, 1962.

X-irradiation kills gametes and gonial cells of the wasp Habrobracon by several means: (1) mitotic rate depression, concurrent, for the most part, with chromosome bridge formation; (2) genetic death through deletion of blocks of essential genes; (3) genetic death through drastic loss of chromosomes or their parts; (4) immediate death of early oocytes or very late gonia before any cell division occurs; and (5) death very late in embryonic development after irradiation of oögonial cells. UV-radiation and nitrogen mustard kill mature Habrobracon oocytes principally through depression of mitotic rate; only a low frequency of deaths are of the gene-loss types. Nitrogen mustard also apparently is capable of inducing Type (4), immediate cell death, a type that cannot be tested with UV-radiation in our system. The mitotic inhibition induced by x-radiation can be reversed only to a limited degree by fertilizing an irradiated egg with an unirradiated sperm. Partial nuclear reactivation of mitotically inhibited cells appears to occur in most of the embryos exposed as oocytes to either UV radiation or nitrogen mustard. It would appear that the mechanism of mitotic rate depression is different between x-radiation, UV and nitrogen mustard. Supporting this contention, nitrogen mustard induces chromosome bridges at a very low frequency at doses where lethality is induced.

- 1166 Brink, N.G. RECOVERY FROM RADIATION AND CHEMICALLY INDUCED PREMUTATIONAL DAMAGE. Papers Proc. roy. Soc., Tasmania 96 (1962) 41-7.

The question of recovery from radiation and chemically induced premutational damage is discussed in relation to the nature of the primary genetic damage at the molecular level, and also in relation to factors which influence the recovery process. Includes studies on Drosophila and broad-beans.

- 1167 Browning, L.S., Altenburg, E. THE CORRELATION OF THE RATIO OF LETHAL TO VISIBLE MUTATIONS WITH THAT OF WHOLE-BODY TO FRACTIONALS INDUCED BY X-RAYS AND CHEMICAL MUTAGENS. (Abstr.) Genetics 48, 8 (1961) 855.

In experiments designed to test the relative rates of lethal and visible mutations induced by x-rays and chemical mutagens (using Muller's Maxy technique) as well as the relative proportion of whole-body and fractional mutations among the viables, it was found that in the x-ray series, the ratio of lethals to viables was much higher than in the case of the chemical mutagens: 78.1 lethals: 1 visible after treatment of the adult males with 3000 r versus 8.7 lethals: 1 visible for dimethyl myleran, 12.9:1 for phenylalanine mustard, and 19.9:1 for ethyleneimino-hydroquinone. However, these proportions of lethals to viables were directly correlated with the ratio of whole-body mutations (viables) to fractionals, being highest for x-rays (113:9 in 159 000 tested chromosomes), lowest for dimethyl myleran (13:26 in

17 000 chromosomes), next lowest for phenylalanine mustard (11:12 in 24 000 chromosomes), and next for ethyleniminehydroquinone (21:9 in 31 000 chromosomes). It is concluded (as suggested by Carlson and Oster) that gonadal lethal mosaics account in large measure for the relatively low rate of detected lethals to visibles in the chemical series, a conclusion in agreement with the earlier work of Auerbach showing that gonadal mosaicism is higher under chemical treatment than under x-rays. (Larger scale tests by us are in progress, similar to those of Auerbach). The present experiments further indicate that the ratio of fractionals to whole-body mutations induced by x-rays is somewhat dose-dependent, being higher for 5000 r (18:95 in 4900 tested chromosomes) than for 3000 r (9:113 in 7700 tested chromosomes). In terms of Muller and Carlson's "rotational substitution" theory, this result might indicate that the higher dose (5000 r) might have caused a relatively higher proportion of breakage of base pairs into single bases with a resultant lower proportion of "rotational substitutions" of the intact base pairs and relatively more single base substitutions.

- 1168 Browning, L.S., Altenburg, E. GONADAL MOSAICISM AS A FACTOR IN DETERMINING THE RATIO OF VISIBLE TO LETHAL MUTATIONS IN Drosophila. Genetics 46 (1961) 1317-21.

The higher the proportion of fractional mutations relative to whole-body produced by treatment of post-meiotic germ cells of the mature Drosophila male with four mutagenic agents, the higher is the ratio of visible mutations to detected recessive lethal mutations. The relative rates are as follows (where % of fractionals is followed by the ratio of visibles to lethals in parentheses): 3000 r x-rays, 7% (1:80); 2, 5 bis-ethyleniminehydroquinone, 30% (1:20); phenylalanine mustard, 52% (1:13); dimethyl myleran, 67% (1:9). This correlation might be explained (as suggested by Carlson and Oster, Rec. Gen. Soc. Amer. 30:1961, 66) on the assumption that gonadal mosaicism would lead to a lowering in the percent of detected lethals, since a gonad which was partly normal (and partly lethal) would appear on further testing to be nonlethal. However, the recovered visible rate would not be similarly depressed by gonadal mosaicism, since visible fractionals would be phenotypically evident. These results necessitate a re-appraisal of the claim that chemical mutagens are specific for visible loci in Drosophila. (Auth, summary)

- 1169 Cantwell, G.E., Henneberry, T.J. THE EFFECTS OF GAMMA RADIATION AND APHOLATE ON THE REPRODUCTIVE TISSUES OF Drosophila melanogaster Meigen. J. Insect Path. 5 (1963) 251-64.

Adult flies were treated with apholate or γ -rays to determine their effects on reproductive tissues. Male and female flies 3 to 4 d old were exposed to 8 or 16 kr of Co^{60} radiation at a rate of ~ 320 r/min or were fed 0.25 or 1% apholate in the diet. Ovaries and testes were removed at daily intervals for microscopic examination. With the higher doses of either treatment, cessation of sperm production occurred in the anterior end of the testes after the 8th day, with a general necrosis of the germinal epithelium in that area. The necrosis progressed until the 19th day when few sperm were observed in the testes of treated males. The ovaries from treated females were reduced in size, and with the high dose of each treatment this noticeable change occurred 2 d following treatment and became more prominent until the 10th day when very little ovarian tissue remained. Very small Feulgen-positive clumps of chromatin indicated that complete breakdown of the nurse cells, oocytes, and follicle cells had occurred in ovarioles. Untreated females mated to males either fed 1% apholate or exposed to 16 kr deposited a large number of eggs, none of which hatched. Since fertilization precedes egg laying in D. melanogaster, it was evident from the egg production data and microscopic examination that sperm transfer was not halted by the levels of either treatment used. Some adults emerged from eggs deposited by untreated females mated to males fed 0.25% apholate or exposed to 8-kr radiation, indicating that the treatments caused development of a lethal factor in some of the sperm which fertilized eggs. No adults emerged from eggs fertilized by males treated with high doses of either treatment which induced lethality in all sperm which fertilized eggs. No eggs were deposited from females irradiated with 16 kr and mated to untreated males and none were deposited after the 2nd day from females fed 1% apholate and mated to untreated males. No adults emerged from the few eggs deposited, corroborating the histopathological investigation, which showed pycnosis and Feulgen-positive chromatin clumps and ovarian atrophy soon after treatment. Females fed 0.25% apholate or exposed to 8 kr and mated to untreated males produced few eggs but some adults emerged. (NSA 18:1964, 1400)

- 1170 Carlson, E.A., Oster, I.I. COMPARATIVE MUTAGENESIS OF THE DUMPY LOCUS IN Drosophila melanogaster. II. MUTATIONAL MOSAICISM INDUCED WITHOUT APPARENT BREAKAGE BY A MONO-FUNCTIONAL ALKYLATING AGENT. Genetics 47 (1962) 561-76.

Monofunctional quinacrine mustard (ICR 100) induces mutations at the dumpy locus with an average frequency of 0.88%. More than 90% of the recovered dumpy mutations are distributed mosaically in somatic

and gonadal tissues. Mutation frequencies at 16 other loci expressing visible effects were low or negligible. These experiments suggest that x-ray-induced mosaic mutations become established primarily at the first synchronous nuclear division of the zygote and that the ICR 100-induced mosaic mutations become established primarily at a later replication. Sex-linked lethals scored in the F_2 occur with a frequency of 3.7%; mosaic sex-linked lethals detected by scoring in the F_2 occur with a frequency of 13.7%. The mutational spectrum of the dumpy alleles induced by x-rays does not differ appreciably from that induced by the ICR 100. ICR 100 is capable of inducing mutations in spermatozoa, spermatids, and the earlier stages of meiosis, including spermatogonia. No evidence for breakage events at the dumpy locus was detected in the progeny derived from ICR 100-treated sperm. The use of the sex-linked lethal test as ordinarily applied, i.e. by examination only of the F_2 generation, for determining the effectiveness of a chemical mutagen or for equating an equivalent roentgen dose to various concentrations of chemical mutagen can be misleading. However, the test can be made more meaningful by continuing the analysis for another generation and/or combining it with a test for visible mutations at specific loci. (Auth.)

- 1171 Caspari, E.W. SOMATIC MUTATIONS IN THE MOTH Ephesia. PROGRESS REPORT. TID-19166, Rochester, N. Y. Univ. Coll. of Arts and Science. Aug. 1963, 25p.

The scales on the hind wing of the moth Ephesia were used as an example of a developing and differentiating system in studies of the effects of x-radiation and chemical mutagens on the genetic structure of developing cells. The chemical mutagens used included 5-bromodesoxyuridine (5-BDU), 5-bromouracil, 2-aminopurine, and 5-BDU plus thymidine. Very little effect was observed after treatment with 2-aminopurine and 5-bromouracil. Possible reaction mechanisms involved in the genetic action of 5-BDU and x-radiation are discussed. (NSA 17: 1963, 31856)

- 1172 Henneberry, T.J., Cantwell, G.E. SOME EFFECTS OF GAMMA RADIATION AND APHOLATE ON THE REPRODUCTIVE TISSUE OF Drosophila melanogaster. (Abstr. 274) Bull. ent. Soc. Amer. 8, 3 (1962) 166.

D. melanogaster male and female flies were exposed to γ -radiation or fed on apholate for 24 h. Whole mounts of dissected ovaries and sectioned testes were examined to determine the effect of treatment.

- 1173 LaChance, L.E., Riemann, J. CYTOGENETIC INVESTIGATIONS ON THE NATURE OF DOMINANT LETHALS INDUCED IN MEIOTIC OOCYTES BY GAMMA RADIATION AND ALKYLATING AGENTS. (Abstr.) Genetics 48, 7 (1963) 896-7.

When adult females of the screwworm fly (Cochliomyia hominivorax) are treated with alkylating agents and ionizing radiation, dominant lethal mutations are induced in the oocytes. Since the meiotic stage of the oocytes is correlated with the age of the females, it is possible to treat oocytes in early prophase, metaphase and anaphase of the first meiotic division. When such treatment is given, fewer dominant lethals are induced in the prophase oocytes than in oocytes in the other two stages. This trend was found in experiments with three alkylating agents and with γ -irradiation. Comparisons between two trifunctional alkylating agents (tretamine = TEM and thiotepa) with a bifunctional agent (2, 5-bis (1-aziridinyl)-3, 6-bis (2-methoxyethyl) p-benzoquinone) reveal that the sensitivity pattern is the same regardless of the mutagen used, but that the mutagenic efficiency of the various agents differs considerably. The cytogenetic investigations permit comparisons of the nature of the chromosome aberrations associated with lethal events. Gamma irradiation of meiotic oocytes with a lethal dose results in a high proportion of chromosomal aberrations during the 1st and 2nd meiotic divisions in the newly laid egg. In oocytes treated with lethal doses of the alkylating agent there is a high percentage of normal appearing meiotic divisions. Dominant lethals induced in the sperm of treated males are expressed during the cleavage divisions following syngamy of the female and male pronuclei.

- 1174 Löbbecke, E.A., Borstel, R.C. von DIFFERENTIAL SENSITIVITY OF Habrobracon OOCYTES IN THE FIRST MEIOTIC PROPHASE AND METAPHASE TO CHEMICAL MUTAGENS. (Abstr.) Genetics 46, 8 (1961) 879.

See 1175

- 1175 Löbbecke, E.A., Borstel, R.C. von MUTATIONAL RESPONSE OF Habrobracon OOCYTES IN METAPHASE AND PROPHASE TO ETHYL METHANESULFONATE AND NITROGEN MUSTARD. Genetics 47, 7 (1962) 853-64.

Ethyl methanesulfonate (EMS) and nitrogen mustard [methyl bis(2-chloroethyl)amine hydrochloride] were used to induce dominant and recessive lethal mutations in the oocytes. Oocytes in the 1st meiotic

metaphase were found to be much more sensitive to EMS and nitrogen mustard (~ 20 times) than oocytes in 1st meiotic prophase when dominant lethality was the criterion. In this respect, the action of the chemical mutagens resembles that of x-radiation. With recessive lethality as criterion, metaphase I and prophase I oocytes respond differently to x-radiation and chemical mutagens. A 2-fold difference prevails after x-irradiation, with metaphase I being the more sensitive stage. With nitrogen mustard, metaphase I is 3-5 times more sensitive than prophase I, and with EMS, no significant difference was found between metaphase I and prophase I. (From auth. summary).

- 1176 LÖbbecke, E. A. MUTATIONAL RESPONSE OF *Habrobracon* OOCYTES IN METAPHASE AND PROPHASE TO ETHYL METHANE SULFONATE AND NITROGEN MUSTARD. (Abstr. BIF967) p. 73 in "Research and Development in Progress. Biology and Medicine. Issue No. 2", TID-4201, Division of Technical Information, USAEC. Nov. 1963.

See 1175.

- 1177 Oster, I. I., Carlson, E. A. COMPARATIVE MUTAGENESIS IN *Drosophila* USING X-RAYS AND ALKYLATING AGENTS. (Abstr.) p. 106 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver Eod Documentary Publications, Ltd., 1962.

The dumpy locus (chromosome II-13.0) in *D. melanogaster* has several easily distinguishable pleiotropic effects and an internal pseudoallelic structure thus far shown to be composed of eight separable sites (Carlson and Southin, 1962). The mode of origin of mutations induced at this locus in mature spermatozoa by x-rays was found to differ markedly from that produced by a monofunctional alkylating agent of the quinacrine series of nitrogen mustards (2-methoxy-6 chloro-9(3-(ethyl-3-chloroethyl) aminopropylamino) acridine dihydrochloride). While the majority of such visible changes following x-irradiation seemed to occur as complete (i. e., whole-body) mutations, those produced by the quinacrine mustard were mainly transmitted mosaically (i. e., only to a part of the somatic and/or germinal tissues arising from any one single treated chromosome). The suggestion that a similar pattern should exist for recessive sex-linked lethal mutations was borne out by the finding that this agent produced fewer complete lethals (4%) (as detected in the conventional manner by examination of the F_2 generation) than mosaic lethals (13%) (as detected in the F_2 generation) in contrast to x-rays which Muller had already investigated in this connection in 1928. As with other chemicals, relatively few translocations could be detected by examination of the F_2 generation. Extension of the analysis to the F_3 generation did not increase this frequency appreciably although it did indicate that even such gross structural changes can occur as mosaics. Studies with a polyfunctional alkylating agent, triethylenemelamine (TEM), carried out as part of an extensive project in collaboration with C. Auerbach and L. Snyder yielded results essentially similar to those found for the monofunctional compound. Comparisons of the response of different gametogenic stages to x-rays and other chemical mutagens has also been studied. (From abstr.)

- 1178 Slizynska, H. MUTAGENIC EFFECTS OF X-RAYS AND FORMALDEHYDE FOOD IN SPERMATOGENESIS OF *Drosophila melanogaster*. *Genet. Res.* 4 (1963) 248-57.

The structural changes induced by x-ray in cells at different stages of spermatogenesis were analysed in salivary gland chromosomes of *D. melanogaster* and compared with the changes induced by formaldehyde added to the food (FF) of the larvae. The different stages of spermatogenesis vary in sensitivity to x-rays when measured by the percentage of sex-linked lethals, by the percentage of spermatozoa carrying structural changes, and by the number of changes per 100 spermatozoa. The proportions of the different types of change (T, In, Rp, Df), however, are fairly similar in all stages of spermatogenesis, but entirely different from those found after FF treatment. This suggests that it is the mutagen and not the sensitive stage which is responsible for the characteristic pattern of the FF effects. The differences between the effects of x-ray and of FF are attributed to the different proportions of potential breaks induced by these two mutagens. Evidence has been presented indicating that while most of FF induced breaks are potential (about 73%), most of the x-ray induced breaks are immediate. For the dose rate used in the present experiment (below 1000 r/min) only a small proportion (3-10%) of breaks induced by x-ray was found to be potential. (Auth)

- 1179 Sobels, F. H. RATES OF FORWARD AND REVERSE MUTATION IN *Drosophila* AFTER EXPOSURE TO MUSTARD GAS AND X-RAYS. *Genetica* 33, 1 (1962) 31-44.

After treatment with mustard gas, reversions of the mutant *forked³ⁿ* were observed with a frequency of 1 in 7500. The study on reversion of *forked³ⁿ* was combined with tests for recessive visibles at 15 selected loci of the X-chromosome. Mutations at the *ruby* locus were most frequently induced by mustard gas (1 in

1700). About $\frac{1}{4}$ of the forward mutations were fractionals. After exposure to 5000 r x-irradiation both reversions of f3n and forward mutation at the loci under study were observed with frequencies comparable to those induced by mustard gas. Thus, no indication for mutagen-specific differences in mutational response have been obtained. After treatment with mustard gas a higher ratio of visibles to lethals was observed than after exposure to x-irradiation. Comparisons of the mutagenic effect of a chemical mutagen with that of x-radiation, even if restricted to visible mutations, inevitably involve an underestimate for the chemical, due to delayed effects of the latter. (From auth. summary)

- 1180 Weidhaas, D. E., Ford, H. R., Gahan, J. B., Smith, C. N. PRELIMINARY OBSERVATIONS ON CHEMO-STERILIZATION OF MOSQUITOES. Proc. N.J. Mosq. Ext. Ass. 48 (1961) 106-9.

Results obtained with radiosterilization are described. It appears that both sexes of Anopheles quadrimaculatus Say can be sterilized by exposing either pupae or adults to γ -radiation in doses of 8865-12 900 r. The presence of such sterile males reduced the total number of viable eggs laid by females caged with mixed populations of sterile and normal males. Field tests on the control of A. quadrimaculatus by the release of sterilized males were, however, unsuccessful. The studies described here were made to determine the effects of aphoxide (tris(1-aziridinyl)phosphine oxide), aphomide (N, N'-ethylenbis-(P, P-bis(1-aziridinyl)-N-methylphosphinic amide)) and apholate (2, 2, 4, 4, 8, 6-hexa(1-aziridinyl)-2, 4, 6-triphospha-1, 3, 5-triazine) and amethopterin (N-(p-((2, 4-diamino-6-pteridinylmethyl)methylamino)benzoyl)glutamic acid) on the fertility of A. quadrimaculatus and Aedes aegypti (L.). Aphoxide, aphomide and amethopterin were used at concentrations of 0.1-1% against both species, and apholate at the same concentrations against Anopheles and at 0.01-5% against Aedes. Mosquitos of both sexes were given continuous access to the compounds in a mixture of honey and water, and a blood-meal was given 4d after peak emergence and again after oviposition. No females of either species oviposited after they had received 1% aphoxide, and none that received 0.5% laid viable eggs. Those that received 0.1% laid the normal number of eggs but hatching was reduced, particularly among eggs laid after the second blood-meal. Aphomide was similar to aphoxide in its effect on egg production in A. quadrimaculatus but less effective than either apholate or aphoxide with Aedes. It reduced the number of eggs laid at 1% and the hatch at all concentrations, but it allowed a few eggs to hatch, even at 1%. Amethopterin had little effect on either species, except for a partial reduction in the hatching of eggs of A. aegypti at 1%.

See also:

- 842 A study of gene and chromosome changes induced by ionizing radiations in Drosophila melanogaster. (Edington, 1963)
 957 The preliminary investigation of salivary gland chromosomes of Chironomus tentans Fabr. from the Clinch river. (Nelson and Blaylock, 1963)
 971 Unequal crossing-over in the bar region of Drosophila melanogaster; influence of temperature, x-rays and EDTA. (Rasmussen, 1961)
 974 Origin of repeats in Drosophila chromosomes. (Slizynska, 1963)
 1330 The influence of X-rays on longevity, fecundity and fertility of Drosophila melanogaster. (Nöthel, 1963)
 1378 Mating ability of male mosquitoes, Aedes aegypti (L.), sterilized chemically or by gamma radiation. (Weidhaas and Schmidt, 1963).

I-A-8 BIOCHEMISTRY. PHYSIOLOGY, ULTRASTRUCTURE. PATHOGEN SUSCEPTIBILITY

- 1181* Aruga, H. MECHANISM OF RESISTANCE TO VIRUS DISEASES IN THE SILKWORM Bombyx mori (IV) (V) (VI). J. seric. Sci., Tokyo 27 (1958) 5-9.

It did not prove possible to produce nuclear or cytoplasmic polyhedra by submitting B. mori larvae to x-rays or ultraviolet radiation.

- 1182 Aruga, H., Yoshitake, N. STUDIES ON THE INDUCTION OF NUCLEAR AND CYTOPLASMIC POLYHEDROSES BY TREATING WITH X-RAYS AND ULTRAVIOLET LIGHT IN THE SILKWORM, Bombyx mori L. Jap. J. appl. Ent. Zool. 5, 1 (1961) 49-56. (In Japanese, with English summary).

No further induction was observed following exposure to ultraviolet light and x-rays respectively. It was only on dual treatment (exposure to x-rays and low temperatures, i. e. 5°C for 24 h) that test larvae showed a higher percentage of deaths from virus than controls. The percentage of larvae with both nuclear and

cytoplasmic evidence of disease was markedly higher when larvae had been treated with x-rays pre- or post-cold treatment than when larvae had been exposed to low temperature only in the 5th instar larval stage, soon after ecdysis. (From summary)

- 1183 Aruga, H. 15. INDUCTION OF VIRUS INFECTIONS. 2. ULTRAVIOLET LIGHT AND X RAYS. p. 507-8 in "Insect Pathology. An Advanced Treatise. Vol. I". Steinhaus, E. A., Ed. New York, Academic Press. 1963.

There was no indication that exposure to x-rays increased the percentage of polyhedrosis-infected larvae of silkworms, but in the case of treatments both with x-rays and low temperature (5°C 24 h), more virus-caused deaths resulted in the test larvae than in the control. The percentage of larvae with nuclear and cytoplasmic polyhedroses was markedly higher in those larvae treated with x-rays before and after cold treatments than in those treated only with low temperature in the 5th instar larval stage, soon after ecdysis.

- 1184 Baccetti, S., De Dominicis, R., Cappellini, M. MODIFICAZIONI ISTOCHIMICHE ED ULTRA-STRUTTURALI INDOTTE DALLE RADIAZIONI IONIZZANTI SUL MESENTERO DI Dacus oleae Gmel. (Histochemical and ultrastructural modifications in the mesenteron of Dacus oleae Gmel. induced by ionizing radiations). Redia 46 (1961) 205-22. (In Italian, with English summary).

Pupae were irradiated with 12 000 to 50 000 r of x-rays, the lowest dose able to produce electronmicroscopically detectable changes being 30 000 r. Higher doses caused injury which differed according to the 3 types of cells found in the mesenteron. Morphologically, such damage consisted of the displacement or disappearance of microvilli, and heavy macroscopic secretion; fragmentation of the nucleoli; and the appearance of vacuoles in the ergastoplasm and Golgi apparatus. From the enzyme point of view, observations indicated the disappearance of succinic-dehydrogenase and cytochromoxidase at the stage of maximum cellular damage. (Work on this topic was published earlier in Redia 45 (1960) 113-31)

- 1185 Baccetti, S., De Dominicis, R. THE EFFECTS OF GAMMA RADIATION ON THE OVARIES OF Dacus Oleae Gmel. p. 387-411 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

The ovaries of unfertilized adult females of the olive fly, Dacus oleae, irradiated in the middle period of the pupal stage with various doses (2-30 kr) of γ -rays were studied by cytological and ultramicroscopic techniques. In all cases the treatment inhibits the normal development of the ovary. Nurse cells and egg cells are very small and few in number and show abnormal structure and ultrastructure, particularly as regards the cytoplasmic organelles.

- 1186 Baumiller, R. C. VIRUS-HOST RELATIONSHIP AND THE EFFECTS OF X-RAY INDUCED MUTANTS IN HETEROZYGOUS CONDITION. (Abstr. 5, 54) p. 73 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S. J., Ed. Oxford, Pergamon Press. 1963.

The only reported phenotypic effect of the "virus" sigma has been to make its Drosophila host sensitive to CO₂. L'Heritier has reported strains of virus-carrying flies which differ according to the stability of the virus-host relationship. The experiments, presently communicated, examined the effects during developmental stages of x-ray induced mutants in heterozygous condition on several of these strains. Sensitive (S) and sibling cured (R) virgin females were collected from the strain to be tested and mated to sibling cured males who had (X) or had not (U) received 3000 r of x-rays. In a cured line the presence of the virus can no longer be demonstrated. After a 2-d mating period the females were placed in net-enclosed cylinders and eggs were collected over 48-h periods. Each hour, beginning with the 21st hour after oviposition, the number of larvae hatching were scored. The effect of mutants in heterozygous condition on time of egg hatching varied according to the stability of the virus in the strain tested. (From abstr.)

- 1187 Grosch, D. S. CYTOLOGICAL INTERPRETATIONS OF FIVE TYPES OF INDUCED MODIFICATION IN THE OVIPOSITION-PATTERN OF THE WASP Habrobracon. (Abstr. 5, 53) p. 73 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S. J., Ed. Oxford, Pergamon Press. 1963.

In contrast to Diptera where ovaries may not mature for several days, at eclosion, differentiated and transitional cells are present in the sequential series provided by the polytrophic ovariole of the parasitoid wasp Habrobracon. Furthermore, ovarioles invariably number only four, and quantitative modifications of

the pattern of egg deposit may be traced back to the cellular state of their contents. When eggs are plotted against days, control females quickly reach a sloping plateau maintained for about 15 d until the sharp senile decline occurs. Low and moderate radiation exposures result in (1) a 2-bumped curve. The interposed valley, which can dip to temporary infecundity, attests to the vulnerability of transitional cells which undergo 5 successive mitotic divisions. High doses of radiation destroy the oögonia as well as transitional cells. This results in (2) a rapid decline to permanent infecundity within the 1st week. Single-meal ingestion of metal cations and classic organic enzyme inhibitors produce a constant deficit throughout life, reflected as (3) a curve lower and parallel to that of controls. A general debility of somatic tissues ensues rather than a direct effect upon the gonads. Ingested antimetabolites can also give type 3 curves, but more typical is (4) an initial lag phase of up to 5 d resulting from oöcyte retardation and degeneration attendant interference with nurse cell function. Nuclear disturbance is involved and may be obtained with agents influencing either protein or nucleic acid synthesis. Aureomycin, methotrexate, DON, or FUDR give similar type 4 curves when used in proper concentration. Antimitotic agents provide still another type of curve (5) characterized by a compensatory deposit of temporarily arrested cells which make up for earlier deficits.

- 1188* Karpov, A. E. ON POLYHEDRAL DISEASE IN THE SILKWORM INDUCED BY X-RAYS. Dopov. Akad. Nauk Ukr. SSR 9 (1959) 1015-18. (In Ukrainian).

Eggs and caterpillars of various instars of the silkworm (breed US-1) were irradiated with soft x-rays ($\lambda = 1, 2 \text{ \AA}$), using doses from 1000 to 80 000 r in order to study polyhedrosis morbidity. Irradiation of eggs with doses over 10 000 r resulted in the death of practically all the embryos but no polyhedrosis was detected. Irradiation of caterpillars with doses from 10 000 to 80 000 r also caused a very high mortality (62 to 97%) due to physiological weakness and to a lesser extent to bacterial diseases. Irradiation with doses from 1000 to 6000 r did not perceptibly affect the development of the caterpillars, but resulted in a significant increase in the frequency of polyhedral disease as compared with the controls. This increase was especially marked when the caterpillars were irradiated with doses of 5000 to 8000 r ($33.5 \pm 3.2\%$ polyhedrosis-diseased individuals as compared with $8.4 \pm 1.8\%$ in the controls). As shown by infection tests, the susceptibility of caterpillars to polyhedrosis did not increase after irradiation. This leads to the conclusion that irradiation causes an activation of latent virus in the silkworm. (Auth.) (NSA 14: 1960, 1881)

- 1189 Kaufmann, B. P., Gay, H. CYTOLOGICAL EVALUATION OF DIFFERENTIAL RADIOSENSITIVITY IN SPERMATOGENOUS CELLS OF Drosophila. p. 375-408 in "Repair from Genetic Radiation Damage". Sobels, F. H., Ed. Oxford, Pergamon Press, 1963.

The radiosensitivity of spermatogenous cells of Drosophila as studied by cytologists and cytogeneticists is reviewed. Radioautographic chronometry, structural changes predisposing to differential radiosensitivity, and the effects of radiations on DNA and on the nucleoprotein complex that constitutes the chromosome are discussed. 93 references are included. (NSA 18: 1964, 11841)

- 1190 Kenworthy, W. RADIATION EFFECTS ON THE CYTOPLASM OF Habrobracon EGGS. Final report, June 1, 1965 - May 31, 1962. TID-16471, Brown Univ., Providence. 31 May 1962. 22p.

The cytological events involved in androgenesis and the rate of production of androgenic males were studied extensively. Eggs which had received sufficiently high x-ray doses for inhibition of functioning of the female pronucleus were examined cytologically. Dose-action survival curves (4200 r - 70 000 r) were plotted for fertilized eggs which had received x-irradiation prior to fertilization. No survivors were found at 42 000 r. The curves were a measure of the production of androgenic males. Neutrons of 14.13 MeV ($8.0 \times 10^9 \text{ n/cm}^2 - 3.14 \times 10^{11} \text{ n/cm}^2$) showed that the more densely ionizing radiations induced higher levels of lethality in eggs irradiated during meiotic metaphase I than in eggs irradiated during meiotic prophase I. Effects of x-rays on cleavage mechanism were studied. In order to allow a study of nuclear and cytoplasmic injury induced by low x-ray doses, attempts were made to produce androgenic males by heat shock and anoxia, applied when the female pronucleus was going through critical stages in its meiotic development. These were abandoned. Attempts were also made to produce such males from hybrid crosses of 2 different species of Habrobracon.

- 1191 McGrath, R. A. X-RAY INDUCED INCORPORATION OF TRITIATED THYMIDINE INTO GRASSHOPPER NEUROBLAST CHROMOSOMES. Dias. Abstr. 23, 9 (1963) 3562.

For abstract, see 1192. Results are interpreted as a reflection of repair of x-ray-damaged DNA. A correlation is suggested between detectable chromosome breakage, the normal DNA synthesis period, and labelling of delayed, stopped or reverted prophase neuroblasts.

- 1192 McGrath, R. A. X-RAY-INDUCED INCORPORATION OF TRITIATED THYMIDINE INTO DEOXYRIBONUCLEIC ACID OF GRASSHOPPER NEUROBLAST CHROMOSOMES. Rad. Res. 19 (1963) 526-37.

Direct observation of irradiated *Chortophaga* neuroblasts at identifiable stages of the cell cycle in the living condition, shows that changes in chromosome morphology which are characteristic of mitotic stoppage or delay can be detected within 15 min after 32 r of x-rays. Four more or less distinct mitotic responses of irradiated prophase neuroblasts can be distinguished, and are discussed, also for a dose of 250 r. Living neuroblasts exposed to tritiated thymidine (H^3 T) and then irradiated in hanging-drop preparations and reidentification of the same cells in autoradiograms of sectioned material show that prophase neuroblasts which are delayed, stopped, or reverted mitotically in response to 32 r of x-rays incorporate H^3 T. Incorporation is greater in cells irradiated in early prophase. No incorporation is observed in cells treated in very late prophase. Labelling can be detected within 15 min after x-irradiation of early or middle prophase neuroblasts. Incorporation is not seen in preparations treated with DNase before application of autoradiographic emulsion. After 250 r of x-rays, prophase cells which do not divide within about 40 min do incorporate H^3 T during reversion to an interphase-like condition.

- 1193 Nakanishi, Y. H., Mizutani, M., Makino, S. QUANTITATIVE MEASUREMENTS ON CHROMOSOME MOVEMENT IN GRASSHOPPER SPERMATOCYTES WHICH HAD RECEIVED BETA-IRRADIATION. (Abstr.) Jap. J. Genet. 36 (1961) 389. (In Japanese).

- 1194 Nicklas, R. B. A QUANTITATIVE STUDY OF CHROMOSOMAL ELASTICITY AND ITS INFLUENCE ON CHROMOSOME MOVEMENT. Chromosoma 14 (1963) 278-95.

Melanoplus differentialis (Locustinae) (from a laboratory population) and *Chortophaga viridifasciata* (Oedipodinae) (from a wild population) were employed; $1\frac{1}{2}$ -5 d before use, the *Melanoplus* males were given 500 r x-rays in 3-4 min. Observations of live cells were made by phase microscopy. Chromosome elasticity and movement were studied in two distinct situations: early anaphase stretch due to opposed external forces (*Chortophaga*), and drag stretch, an elongation due to frictional resistance or drag on a chromosome being pulled towards one pole. Thus, if the *Melanoplus* X-chromosome is partly broken by x-irradiation and its behaviour during 1st spermatocyte division examined, stretching in the region of the break is seen when the chromosome moves. Neither stretch produces detectable alterations in the velocity of chromosome movement. A simple mechanical model is described which allows the ratio between frictional and elastic coefficients to be calculated. It is concluded that the mitotic forces are continually adjusted to produce a standard velocity of movement even when an unusual hindrance exists. The implications are considered particularly concerning stretching and rupture of dikinetochoric ("dicentric") bridges in anaphase.

- 1195* Mathur, R. S. STUDIES ON THE NORMAL AND X-IRRADIATED SPERMATOGENESIS OF *Stenobothrus viridulus* and *Schistocerca gregaria* (ORTHOPTERA). Cellule 61, 2 (1960) 173-90. (In English).

Normal spermatogenesis is described. The effects of x-irradiation (200 r for 5 min 30 sec on the common grasshopper, *S. viridulus*, and 300 r for 6 min 40 sec on the locust, *Schistocerca*) caused the mitochondria and Golgi bodies to fuse in spermatocytes. In *Schistocerca*, the Golgi bodies form an abortive acroblast in a delayed spermatocyte. In both cases the Golgi bodies are displaced from their normal position. The Golgi-idiosome complex can be distinguished in the spermatocytes. The centriole region divides in both species to form 4 bodies. In *Stenobothrus*, a small flagellum develops from each body.

- 1196 Mathur, R. S. THE EFFECT OF X-RADIATION ON THE SPERMATOGENESIS OF *Petrobius maritimus*. Proc. roy. Irish Acad., B 61, 16 (1961) 275-81.

Specimens were subjected to 300 r or 500 r of x-rays, at 50 r/min. These doses proved lethal for spermatogonia. The first visible changes in the spermatocytes and spermatids appeared within 24 h. The nuclei became greatly enlarged and lost their staining power. A lateral thickening was observed along the wall of the elongating spermatid nucleus (the adnuclear fold was also present in normal cells but its development is more easily followed on irradiation). The Golgi body lost its original shape and became very much enlarged, with a lamellar outline and condensation of the granules at the centre. The centriole regions divided into the proximal and distal centrioles. The flagellum seemed to arise from the proximal centriole and to pass through the distal centriole. The flagellum grew out of the cell from an early stage, whereas at no stage in the normal spermatid is the flagellum extra-cellular. Mitochondria

were found to lag behind in the formation of the primitive nebenkern in the earlier stages of development.

- 1197 Mathur, R. S. CYTOCHEMISTRY OF THE NORMAL AND X-IRRADIATED SPERMATOGENESIS OF *Stenobothrus viridulus* (Fischer). *Cytologia*, Tokyo 28, 2 (1963) 113-7.
Stenobothrus (5th instar) were collected and reared to adulthood. An optimum dose of 200 r x-rays (100 kV, 17.5 mA, at 50 cm, with 0.5 mm Al filter) was given, and testes were fixed at 72-h-intervals. The first visible changes occurred after 7 d. In the irradiated nucleus, the site of DNA and basic proteins were clearly marked. The DNA aggregated along the nuclear membrane, the proteins concentrated in the centre. The mitochondria and the mitochondrial nebenkern of the normal material consist of tyrosine and arginine, the outer membrane of the nebenkern containing acidic lipids and cholesterol. In irradiated material, the intensity of the reactions increased with the coagulation of the proteins. Various protein groups coagulated in irradiated spermatocytes. This persisted in the spermatids where the core consisted of protein masses while the membrane maintained its lipoidal nature without showing any irradiation effects. With regard to Golgi bodies which consist of galactogen, acid mucopolysaccharides (sulphuric acid groups only) and acidic lipids, the polysaccharides were observed to lose their staining power on irradiation while the lipids formed the outer membrane. In the acrosome, which is PAS positive and also contains tyrosine, the tyrosine content became more pronounced. The centriole region consists of lipids and proteins. Coagulation of the proteins allowed them to be clearly differentiated from the lipids.
- 1198 Oishi, H. SOME PHASE OPTIC OBSERVATIONS ON THE FORMATION OF A CLEAVAGE FURROW IN BETA-IRRADIATED GRASSHOPPER GERM CELLS. *J. Fac. Sci. Hokkaido Univ., Ser. VI, Zool.* 15, 1 (1962) 37-42.
Podisma sapporensis was used in the study.
- 1199 Струнников, В. А. ОТНОСИТЕЛЬНАЯ ЧУВСТВИТЕЛЬНОСТЬ К РАДИОИЗЛУЧЕНИЯМ ЯДРА И ЦИТОПЛАЗМЫ ПОЛОВЫХ КЛЕТОК ТУТОВОГО ШЕЛКОПРЯДА. Стр. 109-15 в сб. "Труды Ташкентской конференции по мирному использованию атомной энергии", т. 3. Ташкент. 1961.
Strumnikov, V. A. COMPARATIVE RADIOSENSITIVITY OF THE NUCLEUS AND CYTOPLASM OF THE SEXUAL CELLS OF THE MULBERRY SILKWORM. p. 109-15 in "Proceedings of the Tashkent Conference on the Peaceful Uses of Atomic Energy", Vol. 3, Tashkent, 1961.
- 1200 Tahmisián, T. N., Devine, R. L. THE INFLUENCE OF X-RAYS ON ORGANELLE INDUCTION AND DIFFERENTIATION IN GRASSHOPPER SPERMATOGENESIS. *J. biophys. biochem. Cytol.* 9, 1 (1961) 29-45.
The effect of x-irradiation on grasshopper* spermatogenesis was studied with the aid of light and electron microscopy. The insects were irradiated at the 2nd instar prior to the presence of maturation stages and observed at the last instar and imago stages. Dosages of 100 to 800 r were found to retard the differentiation of the nucleus and mitochondrial nebenkern in spermatids. Evidence is presented that irradiation causes a curtailment and disorganization in the differentiation of the nebenkern from mitochondria. The above doses also induced the formation of supernumerary centrioles, flagellar filaments and acrosomes; nuclear disorganization as well as pycnosis and fragmentation also occur. The nucleus appears to be drawn toward each radiation-induced supernumerary acrosome, with consequent multipolarity of the nucleus. Induction of a set of flagellar filaments is seen only where the centriolar structure is in contact with the nucleus. Details are given of an organelle, not described heretofore, that is composed of anastomosed and interwoven cytoplasmic strands. (Auth.)
* *Melanoplus differentialis differentialis* Thomas.
- 1201 Tahmisián, T. N. CYTOLOGICAL EFFECTS. p. 333-52 in "Mechanisms in Radiobiology. Vol. I. General Principles". Errera, M., Forsberg, A., Eds. New York, Academic Press, 1961.
Review article, concentrating on data obtained with grasshopper embryos. The effects of radiation on the nucleus are discussed. Thus, in the resting nucleus subsequent differentiation and not mitosis are stopped. The radiosensitivity of the dividing cell is related to the degree of intracellular differentiation associated with the division process. Radiation causes partial or complete degradation of the mitotic spindle. As for meiosis, the metamorphosis of spermatid to spermatozoon appears to be more sensitive than the meiotic

divisions. Radiation effects on the cytoplasm were studied by the author on Melanoplus differentialis Thomas, particularly by electron microscopy. The effects on centrioles, filaments (spindle, tail structures), mitochondria, Golgi bodies and acrosomes, and on undifferentiated cytoplasm are described.

- 1202 Tahmisián, T. N. AN ELECTRON MICROSCOPE STUDY OF IRRADIATION DAMAGE PRIOR TO MYOGENESIS. (Abstr.) p.226 in "2nd International Congress of Radiation Research, Harrogate, Yorkshire, England. 5-11 August 1962". London, Silver End Documentary Publications, Ltd, 1962.

Using grasshopper embryos (Melanoplus differentialis) it was found, with the aid of the electron microscope, that 50 to 100 r on the 1st day of post-diapause development will abolish myogenesis, which occurs on the 8th day of post-diapause development. Prior to or after the 1st day of post-diapause development, 250 r is ineffective in arresting myogenesis. Sarcoblast nuclei normally contribute to the formation of the Z bands as well as to the myofibrillar filaments. It is possible that the origin of the damage to the inductive process of myogenesis is associated with nuclear DNA because the chromatin as well as the nucleus undergoes karyolysis during muscle formation. The most sensitive generalized biological reaction to x-irradiation appears to involve some "trigger" system that precedes molecular redistribution during morphogenesis. (From abstr.)

- 1203 Vago, C. 11. PREDISPOSITIONS AND INTERRELATIONS IN INSECT DISEASES. 3. IRRADIATION INJURY. p.351 in "Insect Pathology. An Advanced Treatise. Vol. I", Steinhaus, E. A., Ed. New York, Academic Press, 1963.

The effects of various radiations, including x-rays, on the course of certain diseases, e.g. nuclear polyhedrosis in Bombyx mori, is discussed.

See also:

- 863 Cytological effects of x-rays in relation to dose-rate in Drosophila melanogaster. (Gunson, 1962)
 928 Cytogenetic studies following high dosage paternal irradiation in the mealy bug, Planococcus citri (Risso). (Chandra, 1962).
 929 Cytogenetic studies following high dosage paternal irradiation in the mealy bug, Planococcus citri, I. Cytology of X_1 embryos. (Chandra, 1963)
 930 Cytogenetic studies following high dosage paternal irradiation in the mealy bug, Planococcus citri, II. Cytology of X_1 females and the problem of lecanoid sex determination. (Chandra, 1963)
 942 Arrangement of chromosomes in mature sperm. (1) (Herskowitz and Norton, 1963)
 943 Arrangement of chromosomes in mature sperm. (2) (Herskowitz et al., 1963)
 956 Phase cinematography studies on the effects of radiation and chemicals on the cell and the chromosomes. II. Formation of anuclear buds, continuation of chromosome stickiness and formation of an accessory nucleus in grasshopper spermatocytes following x-irradiation. (Nakanishi and Makino, 1960)
 965 Cytological demonstrations of induced breakage in somatic chromosomes of Drosophila. (Oster and Balaban, 1962)
 989 The immediate cytological effects of ionizing radiations. (Carlson, 1958)
 999 Studies of early effects of radiation on chromosomes and mitosis. (Carlson, 1963)
 1009 Methods for estimating differential radiosensitivity. (Oster and Pooley, 1963)
 1013 A cytogenetic study of the effects of x irradiation on Aedes aegypti. (Rai, 1963)
 1100 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)
 1219 Comparative studies of cytochrome c oxidase activity and mutability in two strains of Drosophila. (Ward and Bird, 1962)
 1220 Cytochrome oxidase activity in chromosome interchange stocks of the Oslo and iso-Amherst strains of Drosophila melanogaster. (Ward and Bird, 1963)
 1264 Radiosensitivity of developing reproductive cells in female Cochliomyia hominivorax. (LaChance and Leverich, 1962)
 1299 Effects of x-irradiation upon cell population and morphogenesis in the developing beetle wing. (Beck and Hayes, 1962)
 1300 Cell differentiation and radiopathology in the wing of Tribolium confusum. (Beck, 1962)
 1301 Effects of x-irradiation upon cell population and morphogenesis in the wing of Tribolium confusum. (Beck, 1962)