
Sex-linked recessive lethals were recovered from successive batches of eggs laid by female Drosophila melanogaster irradiated with 8000 r of x-rays. While the initial frequency of lethals (10%) is similar to that of males treated in an identical manner, there is an immediate linear decline in lethal frequency which reaches a value only 60% of the initial frequency in eggs laid 7-12 d after irradiation. The decline in frequency is taken to represent the elimination in immature germ cells of induced lethal effects belonging to the class of chromosome aberrations. The frequency and/or fertility of irradiated females is greatly reduced for the first four days after treatment. A rise in female productivity occurs between days 5 and 6. After a week has passed the productivity of treated females is almost normal, although the eggs produced by the females contain 60% as many sex-linked lethals as the eggs produced immediately after irradiation. The rise in productivity of females from 4 to 6 d after treatment is explained by assuming that the eggs laid at this time were 16-cell cysts at the time of irradiation and were resistant to irradiation in much the same fashion as is polytene tissue. (auth. summary)


The x-ray-induced recessive lethal mutation rate in D. melanogaster has been found to be the same whether or not X chromosomes are modified by the attachment of fragments of the Y chromosome. 8-rays from neutron-activated phosphorus-bakelite plaques are found to be 9% efficient at 50 kv x-rays in producing sex-linked recessive lethal mutations. This difference is attributed to differences in the distribution of lethal products produced in tissue by the two classes of radiation. Reanalysis of earlier data leads to the conclusion that the experimental and calculated values for the fraction of the total 8-particle energy absorbed by the gonad of 88-labelled Drosophila males are not in agreement with what was previously thought. (auth. summary)


The recessive lethal mutation rate/thermal neutron dose relation appears to be linear for sperm up to the highest dose tested (4.5 x 10^13 nuc/cm^2). The relation is also linear for oocytes and oogenesis for doses up to 8.5 x 10^13 nuc/cm^2. The average mutation rate per unit dose for oocytes is 70% the male rate; for oogenesis 30% the male rate. The mutation rate per unit dose for oocytes is 70% the male rate; for oogenesis 30% the male rate. The mutation rate per unit dose for oocytes is 70% the male rate; for oogenesis 30% the male rate. To explain the lower frequency of mutations recovered from oogenesis than from oocytes it is assumed that either the mutation process occurs at a lower frequency in oogenesis than in oocytes or that a large fraction of the potential recessive lethal mutations are drawn off into inviable chromosome recombinations. The basis of energy liberated per unit weight of gonadal tissue, thermal neutrons are found to be 5.5 times as effective as 50 kv x-rays in inducing sex-linked recessive lethal mutations in sperm and 1.8 times as effective in inducing mutation in oocytes and oogenesis. This greater efficiency is not related to the higher mean ionization density of the nitrogen capture poisons which form the physical basis of the action of this radiation. More likely the increased efficiency is due to a greater than average nitrogen content for the Drosophila gonad. (from abstr.)


Germinal tissue of D. melanogaster males and females was used. Nitrogen capture poisons (which are primarily responsible for the biological effects of thermal neutrons in the fruit fly) are approx. 1.5 times as effective in producing sex-linked lethal mutations in sperm as are 50 kv x-rays. Over the range of doses used the mutation rate/dose relation for X chromosomes of sperm appears to be linear. The mutation rate detected in viable eggs laid following treatment remains fairly constant for the first 6 d. Eggs laid 0-8 and 8-24 d following exposure have mutation rates 70% and 80% the original value. This original rate is only 75% the rate for sperm. The difference in the mutation rates induced in the male and female germ line may be due to a difference in mutability between sperm and egg chromosomes treated in late stages of gametogenesis or to differences in the nitrogen concentration between the male and the female gonad. In the female germ line the lower frequency of mutations recovered from perisonic and early meiotic stages than from late meiotic stages may mean that the mutation process occurs at a lower
frequency in less mature cells or that a larger fraction of the potential lethal mutations are driven off into inviable chromosome recombinations. Exposure of males and females to thermal neutrons also produces loss and fragmentation of X chromosomes in germ cells. (auth.)

(Other work was published under the same title as BNL-1795, Brookhaven National Lab., Upton, N.Y., 1958, 23 p.)

**1015**

King, R.C. **DOMINANT LETHAL MUTATION AND X-CHROMOSOME ELIMINATION AFTER X-IRRADIATION OF FEMALE DROSOPHILA MELANOGASTER.** Radiation Res. 2 (1955) 161-69; see also Radiation Res. 2 (1956) 353, abstr. 81.

A study was made of the frequency of dominant lethals and X-chromosome losses found in eggs laid at successive daily intervals after x-ray treatment (2000 r) of female Drosophila. Successive batches of eggs represent cells which were at increasingly early meiotic stages at the time of treatment. No significant difference in fecundity was detected between control and irradiated female flies, which indicates that there is little or no selection for mutant-free cells. The induced mutation rate in successive batches of eggs was found to be similar for the two types of mutation studied. The rate is fairly constant in the first eggs laid, then falls abruptly to a lower constant rate and subsequently declines. The reduction in the rate of dominant lethals in successive batches of eggs is far greater than the reduction in the rate of X-chromosome losses in dominant lethal-free eggs or in the rate of sex-linked recessive lethals in dominant lethal-free, X-bearing eggs. The data are interpreted by assuming x-irradiation induces more chromosome breaks in mature than in immature ovaries. The observed rates for sex-linked recessive lethals and X-chromosome losses in mature cells are reduced to a proportionately greater degree than in immature cells, because higher primary fecundity occurs in more potential mutations are lost by being drawn into chromosome configurations which function as dominant lethal mutations. (auth.)

* King (unpaged) - (1462)

**1016**

Kitamura, J.B. **X-RAY INDUCTION OF DOMINANT LETHAL MUTATIONS IN DROSOPHILA.** Genetics 43 (1956) 353-65.

60 newly emerged dros of a T F1 (200 animals) and F3 (60 forms among 76 F2-hormone populations are extremely rare in certain positions as noted.

* LaChance (1956) - (1258)

**1017**

LaChance, L.E. **INDUCED X-RAYS IN DROSOPHILA MELANOGASTER.** Dominant lethal induced in independent, indicating only

* Translated from Berichte der

**1018**


Differences in the smut and plasmatic heredity. To show from the normal fertilization males to z-rays (2000 r) whether in plasma of their or

* Lee (1956) - (1258)

**1019**

Lee, W.R. **RADIATION IN DROSOPHILA MELANOGASTER.** Genet. 43 (1956) 650.

A queen bee ordinarily lays drone (male) cells. In those with gamma radiation from amount of 10,000 r virtually no lethals. However, when the 1000 cells. This must be de developed into males. The lethal dose, as in Habrobra
dont effects greater than influences. The continuous dose in which given did not change after one year lethals to done its in quantitative significant decrease from 100 cells. This single chromosome breaks at

* Abstract of paper presented 27-29 Aug. 1956

**1020**

Lee, W.R. **THE DOGEOE IN THE HONEY BEE, Genet.** The dosage of y-radiation on dominant lethal dosage, at a egg stage. The proportion of storage in the spermatogenes on dominant lethals being the s by one hour. The curve yel. Drosophila and Habrobracon normal mortality and satura

Six newly enclosed of a Texas strain were given 3800 rad x-rays and reared with untreated 20. Neither F1s (1200 animals) nor F2s (50,000 animals) showed any visible mutations; only F3s (150,000 adults) showed 81 variant forms among 78 F2-husbandflic-matings; 7 mutations are described in some detail. Mutations in natural populations are extremely rare. The gene content appear,however, to be relatively vulnerable to x-rays in certain positions as revealed by a mutation rate of at least 3%.

LaChance 1958 - (1295)


Dominant lethals induced in metaphase 1 eggs of Habrobrachon are chromosomal in nature and are dose-rate independent, indicating only one-hit events. (Auth.)


Differences in the mutual crossing ability of different species of Culex pipifer were interpreted in terms of plasmatic heredity. To show that this phenomenon was not due to a chromosomal mechanism which deviates from the normal fertilization and nuclear division, 4 mutations which occurred after subjecting 2-4 day-old males to x-rays (4000 rad) were studied. Since the mutants studied followed the same course of heredity, whether in plasma of their own or other species, the interpretation presented appears to be correct.

(Translated from Beitrage der zoologischen Biologie. A. 10b (1955) 365)

Lee 1958 - (1298)


A queen bee ordinarily lays fertilised eggs in worker (female) comb cells and unfertilised eggs in larger drone (male) cells. In these experiments queens were inseminated with sperm from unrelated males treated with gamma radiation from Co60. The viability of the eggs in worker cells decreased with increasing dose until 20,000 rad virtually no eggs hatched, indicating that almost every sperm carried at least one dominant lethal. However, when the dosage was further increased to beyond 35,000 rad the eggs began to develop normally. This must be the result of sperm inactivation since the eggs, even though in worker cells, developed into males. Therefore the sperm inactivation dose is several fold higher than the 100% dominant lethal dose, as in Habrobrachon. Nearly all the lethals caused death in the egg stage. There was no significant fractionation effect, the percentage of dominant lethals being the same when 2000 rad was given in a continuous dose as when given in two fractions separated by 1 or 4 h. The proportion of lethals in sperm did not change after one year of storage in the spermatheca of the queen. The curve relating dominant lethals to dose is in quantitative agreement with those of Drosophila and Habrobrachon. It shows a highly significant departure from linearity (after correction for natural mortality and mutation), but approaches linearity at low doses. This is consistent with the hypothesis that dominant lethals are due primarily to single chromosome breaks at low doses and multiple break phenomena at higher doses.


The dosage of X-radiation required to inactivate honeybee sperm is 7 times higher than the nearly 100% dominant lethal dosage, as in Habrobrachon. Nearly all the induced dominant lethals caused death in the egg stage. The proportion of dominant lethals in irradiated spermatocytes did not change after 1 year of storage in the spermatheca of the queen. There was no significant fractionation effect, the percentage of dominant lethals being the same after 2000 rad given in a continuous dose, or in 2 equal fractions separated by one hour. The curve relating dominant lethals to dosage is in quantitative agreement with those of Drosophila and Habrobrachon. It shows a highly significant departure from linearity (after correction for natural mortality and mutation), but approaches linearity at low doses. This is consistent with the
hypothesis that dominant lethals are due primarily to single chromosome breaks at low dosages and multiple break phenomena at higher doses. (from auth.)

1022 Lefèvre, G. Jr. *X-RAY INDUCED GENETIC EFFECTS IN GERMINAL AND SOMATIC TISSUE OF DROSOPHILA MELANOGASTER* (abstr.). *Genetics* 52 (1963) 120. The rate of x-ray induced direct mutations was compared following irradiation of germinial and somatic tissue. Serious question is thrown on the reliability of early reports of x-ray induced reverse mutation in Drosophila. A comparison of the published data regarding the influence of various intrinsic and extrinsic factors on x-ray induced and spontaneous mutation suggests that the two mutation processes are qualitatively different. (This paper was published more fully in Amer. Nat. 84 (1950) 341-48, see ref. 1023)

1023 Lefèvre, G. Jr. *X-RAY-INDUCED GENETIC EFFECTS IN GERMINAL AND SOMATIC TISSUE OF DROSOPHILA MELANOGASTER*. *Amer. Nat.* 54 (1950) 341-48. Attempts were made to induce reverse mutations in both germinial and somatic tissue of Drosophila melanogaster. No evidence of reverse germinial mutation was found following irradiation with 5000 r of some 168,000 recessive X-chromosome loci. In the somatic studies no reverse mutations of white were found in test equivalent to the exposure of 600,000 white loci to 5000 r. White alleles of three diverse origins were used: (a) spontaneous, (b) x-ray-induced, and (c) mutant-yes-induced. The reliability of the early reports of x-ray-induced reverse mutation in Drosophila are seriously questioned on the basis of the results obtained. The conclusion was also reached that x-ray-induced mutability of the w′ locus is not significantly affected by the kind of cell in which it is located. A comparison of the influence of various intrinsic and extrinsic factors on x-ray-induced and spontaneous mutation indicates that the two mutation processes are qualitatively different. In all likelihood induced mutations induced by ionizing radiation in Drosophila, as in man, are losses or destructions of genetic material; and unlike spontaneous mutations, induced mutations are incapable of further change. 50 references. (A4: 6926, 1950)

1024 Lindley, D. L., Beighton, C. W., Hall, B. S. von. *SEX-LINKED RECESSIVE LETHALIS IN DROSOPHILA WHOSE EXPRESSION IS SUPPRESSED BY THE Y CHROMOSOME*. *Genetics* 45 (1960) 1849-59. A method has been devised that allows the detection and recovery of sex-linked recessive lethals whose lethal phenotype is suppressed by the Y chromosome, as well as other lethal genotypes that are inviable with or without a Y. With doses of 3 and 4 kr, ca. 90% of all induced sex-linked recessive lethals survive in the presence of a Y chromosome, and are consequently recoverable by currently used methods of lethal detection. The continuity of the X chromosome is postulated to play an important role in normal spermatogenesis, the continuity being disrupted by reciprocal translocations. (from auth. summary)

1025 Löbbecke, E. A., Muller, L. *ÜBER DIE AUSLÖSUNG VON SOMATISCHEN MUTATIONEN BEI PHYNULA KÖNIGELLA 2. DURCH WELCHE UND MITTELSTRENGE RÖNTGENSTRAHLEN (10-100 KV)* (On the induction with soft and medium-hard x-rays (10-100 KV) of somatic mutations in Phyrella Königelia 2.) Z. Indukt. Abstram.-Verein. Leipzig 99 (1969) 427-42. (In German) Developing lepidopteran larva; mutagenic effect of x-rays (20-100 keV) on a variety of wings of grown up animals were investigated to constitute somatic mutations. The series of tests were carried out at three different times and resulted in scattered results which were not strong that there was no distinct correlation between the frequency of somatic mutations on the one hand and the type of radiation on the other.

1026 Löbbecke, E. A., Müller, M., Königel, L. *ERGÄENDZEIT SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CHRYSTALIN SÜßER PSEUDOS CRYS...
breaks at low dosages and multiple

breaks of different types. (Summary)

In Drosophila melanogaster, treatment of 10 kV x-ray induced nuclear and somatic mutations are observable at low dosages. The dose-effect curves for the somatic and nuclear mutations are similar, but the nuclear mutations are more frequent than the somatic mutations. The results indicate that the rates of detrimental mutations induced in sperm chromosomes vary with the dose and the type of radiation used.
treated in a manner similar to that shown for visible and recessive lethals. The proportion of weak detrimental appeared to be at least 5 times as high as the proportion of strong detrimental or recessive lethals, which are similar to one another. In the female irradiation series the results have not contradicted the earlier observations that recessive lethals induced in unfertilized eggs appear at a slightly lower rate than in sperms, used the first 3 d after irradiation. Further, the relation between the rates of recessive lethals and "strong" detrimental need not be different from that observed in the male irradiation series. It is a remarkable fact that "weak" detrimental are so rare in the female irradiation series.

* Liting and Hendokoff 1959 - [1959]


Recent investigations on the effects of P32 on H. asperus indicate that deviations from the normal occur after exposure. Several of the abnormalities produced give evidence of being true mutations. Each of the mutations following beta radiation resembles one segregated earlier from the progeny of X-radiated females. Each similarity indicates parallel mutation, and the apparent instability of various chromosome segments. The fact that identical phenocopy deviations have occurred following X-radiation and beta radiation lends support to the hypothesis that chromosomes in general are composed of units with varying degrees of stability. (auth. conclusion)


Female workers were picked at random from normal wild-type population. Among progeny of exposed females there were an avg. of 5% abnormal individuals as compared with 1-2% in controls. Abnormalities were most common in the wings. Some of the evidence indicates that P32 may produce sterility and mutations as well as increase of atypical individuals. Such evidence should be taken into account in the use of P32 for treatment of human disorders. (64, 28: 1960, 1972)


A comparison is made between the radiations from a linear accelerator at 4 MeV and 300 KV X-rays. Among other tests, the mutations induced in Drosophila were examined. (Further papers are published in this series.)

* Mickey 1954 - [1840]

* Mickey and Tander 1954 - [1840]


It is found that Drosophila males will fertilize as many as 10 virgin females per day and that, in order to achieve maximum utilization of sperm, it is necessary to mate males with large numbers of virgin females daily. It is demonstrated that mature sperm are retained in the testis at least a few days. When newly emerged males are irradiated with 2500 r and mated according to the above system, there is a decided decrease in mating activity and an increase in dominant lethals on the 4th to 5th day after irradiation. (auth. summary)

* Moncorg 1956 - [1841]

* Moncorg 1955 - [1841]

* Moncorg and Opherd 1958 - [1841]

* Muller et al. 1960 - [1911]


The frequency of translocation vary linearly with dose even at that broken chromosomes ends of with another much farther by the same track to occur. Thus the pieces would usually be inferred in this material a deuces it, i.e., that remote by stable intermediates or molecular conjunction is provided by the length mutations seldom accompany other rearrangement, give with even when there is no cytologic close parallelism (whether in the same from the crowding of that type remained narrowly localized.

(See Soc. Genet. Soc. Amer. 2)


The production of gene and chro some is reviewed. Comparative interpretation are discussed, consideration, nuclear sex observation that the X-rays in their production of that of X-rays would rise until the production of translocations.

* Muller 1954 - [1940]

1008 Muller, H. L., Henikowitsch, J. H. X-RAY DOSE AND RECOVERY.

The experimental data on cells at the time of radiation mutative correlation between genocentric effect of X-rays. It is pointed out in the germ cells of a period that be present to some extent in the and the fact that in most earlier stage was not realised, the sign it rated frequency-dose relation linearity in this dosage region is material of maximal homogeneity.


The author disputes the frequency-dose relation at is different cell types. A section i rate and the spontaneous rate. A outline in interpretation are consid

(Also published in Progress in L. H. Brucher, J. G., Cousens, T., L. N.)
The proportion of weak detrimental or recessive lethals, it have not contradicted the argument at a slightly lower rate than the rate of recessive lethal male irradiation series. It is a common series.

IN HARBOURGARRON FINDINGS

Variations from the normal occur among true mutations. Each of the three progeny of x-irradiated females, various chromosome segments, radiation and beta radiation tends to appear with varying degrees of stability.

PHOSPHORUS ON HARBOURGARRON

Among progeny of exposed 1-2% in controls. Abnormalities may produce sterility and mutation taken into account in the use of MeV and 200 KV RADIATIONS, BITAL AND HOLT RADUUM. (1957) 357-8.

Further papers are published in 1957 and 300 KV X-rays.

MELANOCASTER. Amer.

1/10 th day and that, in order to maintain a large number of virgin females in a very small area, there is a decided advantage in using them in a 3rd day after irradiation.


The frequency of translocations induced by fast neutron irradiation of Drosophila spermatozoa was found to vary linearly with dose even at doses sufficient to produce multiple proton tracks per sperm. This shows that broken chromosome ends derived from different breaks caused by the same track undergo recombination with one another much oftener than those of different tracks. Our interpretation is that breaks caused by the same track tend to occur near together, thus promoting a translocation between the broken ends. Thus the pieces would usually unite before greatly changing their relative positions. It must further be inferred that in this material a break usually occurs close to the point of origin of the ionization that induced it, and that remote breakage effects, resulting from migration of ionization induced, relatively viable microsomal segments, are uncommon. Further evidence for this conclusion is provided by the finding that loci, like those for white eyes, which with X-rays give "visible mutants" seldom accompanied by a lethal effect unless there is a microscopically visible deficiency or other rearrangement, give with neutrons "visible mutations" that are usually accompanied by a lethal effect, even when there is no detectable chromosomal alteration. This concentration of two mutagenic effects in close proximity (whether in these cases usually broken or gene mutations or both is not yet decided) would result from the crowding of ionizations in proton tracks, provided the mutagenic action of the ionizations remained narrowly localized.

(See Rec. Genet. Soc. Amer. 20 (1953) 131-6)

1037 Muller, H. J. THE RELATION OF NEUTRON DOSE TO CHROMOSOME CHANGES AND POINT MUTATIONS IN DROSOPHILA. I TRANSLocations. AMER. NAT. 88 (1954) 487-98.

The production of gene and chromosome changes by the application of fast neutrons to Drosophila spermatozoa is reviewed. Comparable series of experiments with X-rays are also considered. The results and their interpretation are discussed. At a level of doses yielding a 10% frequency of the translocations, under consideration, neutrons at observed under the experimental conditions are 2.5 times as efficient as X-rays in their production of translocations, with lower doses their efficiency in this respect, relative to that of X-rays, would rise until that very low level of dosage was reached below which, according to theory, the production of translocations by X-rays also became linear.

Muller 1954 - (545)


From the experimental data obtained, the authors inferred that heterogeneity in susceptibility of the germ cells at the time of irradiation must be taken into account when interpreting results. There is a strong positive correlation between susceptibility to the chromosome breaking and that to the recessive lethal inducing effect of X-rays. It is pointed out that heterogeneity of a similar kind probably exists, to a lesser extent, in the germ cells of a period shortly before ejaculation, when older males are used, and that it may even be present to some extent in the germ cells of that period in young males. In view of these considerations, and the fact that in most earlier work the importance of usually controlling parental age and germ-cell stage was not realized, the significance of earlier data reporting to show the continuing linearity of the lethal frequency-dose relation at high doses becomes uncertain, and conclusions based on a supposed linearity in the dosage region should be held in abeyance until more definitive data can be obtained on material of maximal homogeneity. (From author summary)


An invited address. The author reviews the significance of Drosophila data by various workers. After discussing the frequency-dose relationship at low and moderate doses, the author considers the different susceptibilities of different cell types. A section is devoted to discussing the relation between the induced point-mutation rate and the spontaneous rate. Mutational mechanism, the conditions under which they operate, and difficulties in interpretation are considered. 68 refs.

Murai et al. 1967 - [1967]


Summarizes are presented from studies on the genetic effects of radiation on populations of Drosophila and yeast. A discussion is included of methods for the determination of optimum mutation rates and degree of dominance by the principle of minimum genetic load. (No 15: 6566, 1961)


Three x-ray induced translocations among the chromosomes of A. eucypheraus (Orthoptera) have been observed, and are described.


Genetic effects of irradiated cytoplasm on untreated introduced chromosomes were demonstrated by the appearance of mosaic eggs in the progeny of x-irradiated female silkworms of genotype pe pe pe pe, mated to wild-type unirradiated males. Since it was considered that the mutagenic power of irradiated cytoplasm might be lost if the interval between irradiation and fertilization was too long, and in order to shorten the interval between irradiation and egg laying, the females were kept at about 10°C for 12 h previous to irradiation, and the period within which mating was possible was restricted to 2 or 4 h. (NSA 7r 6335, 1953)


An attempt was made to determine whether mercaptoethylamine (MEA) and cysteine protect the silkworm against mutagenic and lethal effects of radiation, using visible mutations (egg colour mutants) and lethals. The wild-type female moth, which received the injection of MEA, cysteine or physiological salt solution (control), were irradiated with x-rays and then mated to double recessive pe pe pe pe males. In other experiments, eggs laid from the mating of wild females and pe pe pe males were collected for MEA solution before irradiation. In either case, the mutation rates were estimated at unirradiated males showing loci by examining the egg colour. There was no protective action of MEA and cysteine against the mutagenic and lethal effects of irradiation in these experiments. (auth. summary)


An attempt is made to compare the pattern of x-ray induced mutation rates at two loci (pe and e) along the same chromosome (Y). Both control egg and eye colours. The results are tabulated. The total mutation rates increased more rapidly following irradiation of females than of males. The results of some unpublished work by Y. Tatima are quoted who irradiated pupae and larvae. The total mutation rates produced by the same dose of x-rays at both loci were higher after female than after male treatment; the ratio of mutation rate at the pe- and the pe-locus proved to be 1.5 to 3.5 after treatment of males, and 1 to 2 after treatment of females.

Nakao 1957 - [1402]

Nakao 1958 - [1414]


Dose-effect curves for the two radiations were established for brain damage induced in the 6h-old chrysalid stage of Drosophila. Individual brains showed variable radiosensitivity and a linear damage curve with increasing dose. The changes induced were interpreted as representing pheno-phenotypic changes of known mutations, caused by chromosome damage.


Experiments were carried spermatogenesis on the first explanation are discussed

Oftedal and Mosige 195

Oftedal and Morgen 195

Oftedal 1956 - [1433]

Oftedal 1956 - [1433]

Oster 1955 - [1218]

Oster 1956 - [1218]

Oster 1957 - [1217]


The exposure of individuals to lead to an acceleration occurred when it was found that x-rays than females. Egg related stocks. This two: duals were exposed to 12 were rapidly dry. The era in chemochemical morphological visualized is shown. The in abnormalities, lack of microscopy. Morbidity, frequently among late ps, demonstrate that this x-rays obtained previously cause larvae having one and two

Oster, W., Müller, H. Science 128, 3280 (1958)

The reason for the most work and the sciences own

Oster, L. L., Zimmering, THAN INTENSE RADIATION

Experiments were carried of short γ-ray radiation report less conclusive evidence: production of ordinary life from a radio source, one g atom.

Paget 1954 - [1446]
Experiments were carried out in order to study the causes of the difference in dominant lethals carried by spontaneous on the first and second day following irradiation. The problems involved and their possible explanation are discussed in the light of some experimental data obtained by the authors on Droeschella.

* Otsuka and Morita 1957 [397]
* Otsuka and Morita 1956 [396]
* Otsuka 1956 [395]
* Otsuka 1955 [1217]
* Otsuka 1955 [1216]
* Otsuka 1957 [1218]

The exposure of individuals to radiation, especially resulting in damage to various organ systems, was found to lead to an acceleration of the so-called "natural" aging processes. A breakdown on this problem occurred when it was found that male larvae of Drosophila melanogaster are more susceptible to killing by x-rays than females. Experiments were conducted with hybrid third instar larvae from crosses of two unrelated stocks. This avoided the use of individuals already homozygous for deleterious genes. The individuals were exposed to 1200 r (100 kV, 20 mA; 1 mm Al filtration, 100 r/min) when their outer surfaces were fairly dry. The males and females resembled each other genetically and phenotypically but differed in chromosomal morphology. The scheme used to obtain ring- and rod-shaped chromosome-bearing individuals is shown. The majority of the irradiated individuals which reached adulthood showed extreme wing abnormalities, lack of many bristles, and marked weakness which was presumably due to damage to the musculature. Mortality in those cases in which it occurred during the pre-imaginal stages occurred most frequently among late pupae and very rarely during the late larval and early pupal instars. These results demonstrate that this x-ray induced life-span shortening has a genic basis, and that complement data obtained previously concerning the susceptibility to x-ray induced somatic damage of male and female larvae having one and two X chromosomes, respectively. (NSA 14: 34912, 1950)

1048 Ooster, W., Muller, H. J. GENETIC BASIS OF SOMATIC DAMAGE PRODUCED BY RADIATION. (abstr.) Science 190, 3098 (1955) 1422-3.  
The reasons for the mortality caused by irradiating Drosophila larvae are discussed. In the light of Ooster's work and the authors' own findings.

Experiments were carried out to test whether the principle of lower mutagenic effectiveness of chronic than of acute y-radiation is found for mouse embryos also holds for Drosophila. It was found to be the case. Less conclusive evidence indicates that the same principle holds in Drosophila spermatozoa, both for the production of ordinary lethals and of minute deficiencies. The respective dosages applied were 5000 r from a Co60 source, one group of flies getting 13 r/h for 2 weeks, the other the whole dose in 31 r. (from abstr.)

* Paget 1954 [1446]

Mutations were induced in Culex fatigans by exposure to X-rays. Four morphological aberrations were observed in the first generation following exposure of normal laboratory-bred pupae. Mosquitoes with only one of the mutations were bred successfully. Details of the first generation are tabulated. (NSA 14: 1280, 1960)


For the majority of the biological reactions to radiation previously investigated, including the killing of Drosophila eggs and larvae by radiation, fast electrons are less effective than X-rays (250 kV). In the determination of sex-bound initial factors induced by radiation in Drosophila, no difference was found between the 2 qualities of radiation regardless of whether mature or immature sperm were exposed. The results apply to the behaviour induced by irradiation of single chromosome fragments in Drosophila. The results are discussed with reference to the theory of this.


The complexity of scale formation at the base of the wing is described. Irradiation of larvae in the final stage with X-rays causes the homogamous females to develop dark scales, singly or in patches, on their hind wings. This rarely occurs in the homogamous males. These may be traced to somatic mutations which give rise to a recessive sex-linked factor. The size and frequency of occurrence of such spots following irradiation of larvae of different ages is described. Mutations and their qualitative and quantitative significance are discussed.


Treatments of 4-5-day-old larvae of the final stage with 1500 r of hard X-rays produced isolated or clusters of mutant scales on the hind wings. They belong to different types of mutation, with very different frequencies of occurrence, and may be divided into two groups. Their distribution amongst the sexes, location on the wing surface, frequency of occurrence, and the effect of increasing larval age at the time of irradiation are discussed.

1054 Pohley, H.-F., Ernst, H. ÜBER DAS VERHALTEN MUTAMTER SCHUPPEN AUF DEN HINTERFLÜGELN DER MEHLMMOTTE EUPHESIS KÜHNELLA NACH RÖMEMEITSTRAHLUNGEN (Study on the reaction of mutant scales on the hind wings of the Mediterranean flour moth, Ephesia kühnella, following irradiation of pupae). Z. Entomol. Abh. Verh. 19, 6 (1958) 701-34. (In German)

Pupae of various ages were subjected to hard X-rays. The scaled hind wings of the moth were checked for mutant scales. The appearance of concentrations of such mutants, their frequency and reaction under different conditions of irradiation are discussed. The frequency was found to drop with increasing age of the pupae at the time of irradiation.


Unmated females X-rayed with doses ranging from 1540 to 3530 r have given bright eye-colour mutant sons in percentages ranging from 6.44 to 6.88. Similar mutants are found less frequently at lower doses. Data are thus far consistent with direct proportionally.
Eukaryen Eines 0-keV (ron) Z. Naturf. 56, 7 (1951),


X-ray dose-action curves for visible mutations in Drosophila are discussed and a curve for eye-colour mutations in Mormonielia presented. They were essentially linear, indicating single hits producing the mutations. An insignificant dip at 2888 r was observed in Mormonielia.


Mormonielia vispirennis Walker, a chalcidoidea wasp parasitic on blowfly pupae is especially suitable for the study of dose-action curves, especially for the low dosages of X-rays. By irradiating virgin females and examining their offspring (which are all haploid males) it is possible to obtain the large numbers of organisms necessary to reduce the confidence limits of dose-action curves. The numerous X-ray induced eye-colour mutations from wild type present a group of mutations easy to score. The wild-type eye colour of Mormonielia is a dark brown. The eye-colour mutations vary from dark red through orange white; the intermediate colours within these limits are orange, red, scarlet and orange-peach. Twenty-six high-dosage experiments and 42 low-dosage experiments were performed with reference to dose-action. Additional low and high dosage experiments were performed with reference to the testing of mutants. (from abstr.)


Quantitative data on the frequency of dicentric bridges with fragments in irradiated meiotic chromosomes of grasshoppers were obtained by direct cytological examination. The dicentric bridges were detected at the first anaphase of meiosis by irradiating the testes of the grasshopper Gomphocera functiones, a species with 22 acrocentric chromosomes in the males. (N.A. 1: 1064, 1953)


The frequencies of bridges were found to be independent of the intensity of the γ-radiation within the limits of the experiments described in this study. These results, coupled with the fact that the frequencies of bridges are in direct proportion to X-ray doses confirm the impression that the bridges originated not through independent breaks in a chromosome but largely from a single break in an unspli chromosome, caused by a single ionisation track.


A method which enables the statistical variance of several characters to be measured at the same time was used. By a suitable crossing scheme with Drosophila melanogaster it is possible to make standard irradiated third chromosomes homozygous in in genetic background identical with the labile line providing the third chromosomes. A number of such strains have been produced, using an X-ray dosage of 4000 r and both the homozygous strains and intercrosses between them have been raised under standard condition. Wing and thorax length and the numbers of meristic and stomodial hairs were estimated on these strains and crosses, and also on control stocks obtained by the same mating scheme without irradiation. Strains in which third chromosomes from a wild stock were made homozygous in the same inbred genetic background were also studied, to give a standard against which the radiation-induced genetic variance could be compared. The environmental variance in body size among individuals of the same genotype was, on the average, greater for the homozygous strains than for their intercrosses. This suggests that the third chromosome heterozygosity induced by 4000 r of X-rays was sufficient to increase the environmental stability of the intercrosses over that of the homozygotes. (from auth.)

Male Drosophila melanogaster received a single dose of 2000, 5000 or 7000 r of x-rays at 100 r/min. All the irradiated X-chromosomes which were tested for mutations were obtained from sperm which functioned in fertilization within 20 of the treatment. The average percentage mutation per 1000 r high-energy X-rays is 1.7%. The corresponding figure for ordinary X-rays as given in the literature is 2.9%. This result indicates that the high-energy radiation is only 1/4 as effective as ordinary X-rays for the production of lethal mutations. The reason for the difference in effectiveness is discussed. \( \text{NASA A 5} \) (1953, 1950)


The incidence of spontaneous chromosome aberrations in first metaphase plates of Chlorestes males is estimated to be 0.1 incomplete breaks, 0.02 complete breaks, and 0.02 interchanges per cell. After an X-ray dose of 100 r the following classes of induced chromosome aberrations come successively into maximum: (1) Incomplete breaks (54%), (2) "stickiness" (G 4), (3) complete breaks (10%), (4) interchanges (16%), (5) incomplete nuclei (7%). Over the range 2 to 300 r, 0.66 incomplete breaks are obtained per nucleus per r. If the dose-effect curve remains linear at even lower doses, natural internal radiations cannot account for more than half of the spontaneous abnormalities of this type. Similar conclusions were obtained with regard to the complete breaks and interchanges. These findings were tested directly by growing grasshoppers at various distances from a Co\(^{60}\) source for 20 d. A dose rate of 500 r background was required to produce a clearly significant increase in chromosome aberrations over control animals.


New data was obtained from irradiation of the same cell stage as that investigated in the mouse, i.e. the spermatogonial stage. Comparing the mouse radiation-induced mutation rates with genetically tested mutations with comparable data in Drosophila gives an estimate of 5 as the ratio of the mouse rate to the Drosophila rate. The general magnitude of this ratio is also supported by several recent estimates of Drosophila mutation rates for autosomal loci in post-spermatogonial cell stages, provided due regard is paid to the differences between cell stages. "This" (1954) conclusion that the radiation-induced mutation rate appears to be similar in flies and mice is disputed on several grounds. Comparison between species as different as Drosophila and the mouse is difficult. It is not maintained that a final answer has been reached on the relative radiation-induced mutation rates of the two species.

1064 Saal, G. R., II. THE INDUCTION BY X-RAYS OF RECESSIVE LETHALS IN THE MAJOREM STRAIN OF MAMMONTI, VITAMINEN (WALKER), Radiation Res. 7 (1966) 467-60.

Male males of the choriobileum X-ray sensitive homothallic vitamin (Walker) were treated with X-rays at doses between 500 r and 3112 r and were then mated to virgin females differing from them by a single locus at a single locus. A statistically significant deviation from a 1:1 ratio of the alleles in the F\(_2\) progeny of an unmated \( F_1 \) female was taken to indicate the presence of a recessive lethal linked to the genetic marker. The numbers of lethals linked to two separate loci were computed for each dose administered. No evidence was obtained against the assumption of a linear dose-action curve for recessive lethals linked to either of the visible markers studied. The combined data for the two loci also showed no significant departure from linearity. Mutation rate \( x \) was calculated as 0.00064 for lethals linked to one locus, as the \( F_2 \) locus, and as 0.00114 for lethals linked to another locus, known as the \( F_2 \) locus. The combined rate for both groups of lethals was 0.00069. The method did not measure the spontaneous rate of mutation of indicate any differences in the number of lethals carried in the races used in the experiments. The proportion of lethals linked to the \( F_2 \) locus is greater than the proportion linked to the \( F_2 \) locus at all doses of X-rays. This may be due to differences in radiosensitivities or crossing-over frequencies of the chromosomes involved, or to the possible location of the close to the end of a chromosome. Recessive lethals can exert their effects at any stage of development between the egg and the adult. (Auth.)

1065 Schacht, L. E. THE USE OF DROSOPHILA MELANOGASTER. A comparison was made to bacterial strains in the chrom some region.

1066 Sero 1954 - (1950)

1067 Shaw, F. A. THE EXISTENCE OF MUTATIONS DURING INDUCTION OF MUTATIONS. The extreme sensitivity of an unknown X-ray treatment was 4 of 1000 r potential treatment during irradiation of human conditions. The dose was no threshold and the range is 8-30 r in the few cases. The dose was given by a mechanism which inhibited caused by doses. A threshold, R appears, the doses and the time of specific carriers, and these are producing the major power.

1068 Shields, J. W., SLATER, J. Carrier, W. E. BIOLOGICAL PHYSICAL AND DESTRUCTION OF COHERENT ORIC, 88-in electron microscope. A recent improvement, the necessary difficulties times by various carriers, the earlier literature. At occurred, since the applied are given. Typical equivalent chromosome, and

1069 Sobol, J. 1953 - (1410)

1070 Sobol, J. 1954 - (1411, 141)

1071 Sobol, J. 1955 - (1413)

1072 Sobol, J. 1960 - (1417, 141)


D. viridis were placed at a g- and other ionizing radiations. Transplantation rates were p- theory that the number of seeds is much more of this was modified and 2000 r, and 1500 r long frequency indicated.
1066 Schaebe, L. E. THE TIME OF X-RAY INDUCTION OF CROSSOVERS AND OF TRANSLocations IN PHOENICOLA MELANOCASTER MALES. Genetics 43 (1958) 665-75.

A comparison was made between the time of recovery of induced crossovers and time of recovery of induced translocations in the chromosomes of irradiated Phoenicola. (RNA 18: 8560, 1966)

1066 Sato 1964 - [1263]


The extreme sensitivity of the grasshopper neuroblast to radiation-induced mitotic inhibition makes the determination of the dose-effect relationship very difficult, because 10% inhibition may be produced by as little as 4 r of 120-kv potential x-rays with 3.5 mm of Al filtration. By the use of sodium hydroxide (NaOH) treatment during irradiation, a fourfold reduction in the sensitivity of the neuroblast was produced by the anoxic condition. The dose-effect relationship proved to be logarithmic in the range 3-64 r. There was no threshold and the 10% dose was approximately 20 r. Carlson, Ogden, and Halseth found that under aerobic conditions the amount of mitotic inhibition was independent of dose rate (0.5-90 r/min) in the range 3-32 r. In the low dose range x-ray-induced mitotic inhibition occurs as a phenomenon of short duration caused by a mechanism involving first-order kinetics. In contrast, a major portion of the mitotic inhibition caused by doses of x-rays greater than 150 r is of long duration, is dose-rate dependent, and has a threshold. It appears, therefore, that x-ray-induced mitotic inhibition in the dose range below 80 r under aerobic conditions is caused by a mechanism distinct from the one that produces the major portion of mitotic inhibition at doses of 150 r or greater.

1066 Beaver 1967 - [1847]


Production of dominant lethal mutations in Phoenicola by fast neutrons has been reinvestigated with the CERN 80-inch cyclotron. A number of changes, checks and improvements in dosimetry are described. With these improvements, the new CERNE 60 isotope is at least as effective at high doses. Results of experiments at different times by various investigators here are now consistent. The RBE values are still not in accord with the earlier literature, presumably owing to physical dosimetry errors. Even in our earlier studies, errors occurred, resulting in doses which were too high by 30 to 100%. References to which corruptions are to be applied are given. Typical sources of error are lack of saturation of ion chambers, misuse of tissue-equivalent chambers, and spectral dependence of chamber response. (abst. summary)

1067 Sobole 1965 - [1410]

1067 Sobole 1966 - [1411, 1412]

1067 Sobole 1967 - [1413]

1067 Sobole 1968 - [1417, 1418]


D. virile was placed at neutron stations at different distances from the centre of detonation, screened from x-ray and other ionizing radiation, and from excessive heat. The complex translocations obtained are tabulated. Translocation rates were plotted against estimated rep calculated for each test station. The data support the theory that the number of translocations produced is directly proportional to dosage of fast neutrons. Fast neutrons are much more effective than x-rays in producing genetic damage measured as translocations. This difference is more marked at lower doses. A rough equivalence to damage exists for 100 rep and 750 r, 500 rep and 2000 r, and 1390 rep and 4600 r. The direct proportionality between fast neutron dosage and translocation frequency indicates that small doses of neutrons are relatively more dangerous to genetic systems

1068
than small doses of x-rays. The estimates of equivalent damage showing the difference in effectiveness of neutrons and x-rays agree with the report of Baker and von Malle (1954) using dominant lethals in Drosophila.

* * * * *

Sormovskii, 1956 - [599]

Sormovskii, 1957 - [597]

Sormovskii and Sormovskii, 1958 - [598]


A search of the offspring of irradiated houseflies has resulted in the discovery of a number of mutations. Most of the mutations affect the wings. Bicoids were found in the subcortex, the anterior and posterior cross veins, and the anterior and posterior regions of the fourth longitudinal vein. Additional veins have been found arising from the posterior cross vein and in the posterior regions of the fourth longitudinal vein. Other wing characters are: cuticle wings, vestigial (unexpanded) wings, and scalloping of the posterior margin and wing tip. Some of these are similar to mutations found by Dr. Millani of Pavia, Italy. One mutation affects the legs, causing a swelling, shortening and twisting of the femora. In all the above cases the penetrance and expression of the characters is highly variable. There is considerable serial and bilateral asymmetry in the expression of various characters. The character "shortens" causes a reduction of all bristles on the head, thorax and abdomen, leaving a short stubble. This character is lethal to flies prior to oviposition, lacking visible effect in heterozygous flies. Another character has been found which causes all male progeny. This character does not alter the size of progeny produced, indicating action prior to oviposition. All characters found to date appear to be recessive.

(Abstract of paper presented at the 1957 meetings of the Genetics Society of America, Stanford, California, 26-28 Aug. 1957)


Two mutants of larval marking pale stripped (p52) and second striped (o52) were found in the F2 of the crossing of p52/p52 X o52/o52 female with a p52/p52 male, the female having been treated with x-rays 7 to 8 d after pupation. The mutants and their genetic origin are described in detail. A lengthy English summary presents all significant data. (NODA T; 1956, 1957)


Since mutant characters have not been expressed with respect to the same stage (e.g., egg or adult) this also affects the evaluation of relative mutation rates.

* Tazima, 1958 - [991]


In the silkworm the development of the germ cells in the gonads is in direct accordance with the development of the individual (both male and female), thus facilitating interpretation of results. Wild type adults were irradiated with doses from 500 to 4000 r at various stages of larval and pupal development and mated to non-irradiated partners. At 2000 r, a noticeable decrease in oviposition resulted in early-irradiated females. Males reacted very differently. A markedly sensitive period was discovered at the early 6th stadium (early spermatogonia stage of germ cells) leading to a marked decrease in subsequent oviposition even at 500 r. The frequencies of unfertilized eggs and early lethals are analyzed.

* Tazima, Y., Osakada, K. RESPONSE PATTERN OF SILK WORMS. Mishima. Nat. Inst. Genet. A Recession mutation rates at 500 r was concluded that the germ cell generation and as oocytes, whereas

Teus, M. ÜBER DIE AUSWIRKUNGEN DES GESCHLECHTSGESCHLECHTS- DROSOPHILA MELANOGASTER I. sex-linked lethal factor on the Y-chromosome (D) (1956) 503-5.

Utilizing a dual-purposes stock and recessive sex-linked lethal existing discrepancy in the deg irradiated germ cell is explicit of the blood pattern an excess - sensitivity expected for immat-

* Teus, 1956 - [426]

Ulrich, H., THE MUTAGENIC DEPENDENCE UPON OXYGEN. Genetics. Montreal 1931, Vo. 16. Egs of D. melanogaster were x-rayed posterior halves being toned, and dose-effect curves e due to the induction of domino egg by damaging the cytoplasmic lethal, on account of their low of adult flies seems to offer not indirect or delayed effects, de-

* Ulrich, 1956 - [426]

Ulrich, H., STREULINGENGENETICS ON DROSOPHILA EGS. The mutation rates obtained of egl are consistently on Muler 5-moschus was used.

* Ulrich, 1957 - [426]

Ulrich, H., DIE MUTAGENISCHE UND TREERNSCHEFFER A N O X Y G E N D E P E N D E N C E . When 10-20 m-r-old (Drosophila) of I. 27% of sex-linked recessive mated with Muller 5-males), the LD50 being 500 r and sex-"H
diagnosis had no effect.

* Ulrich, 1957 - [426]

Valentino, L. L. CHROMOSOMAL MUTAGENICALLY COMPARE 602. Mature spermatozoa were given linked lethals at a frequency (1 produced in spermatozoa by ut lethals included 11 to 12 cyto in the mating doses of the r
TRAUT, H. ÜBER DIE ABHÄNGIGKEIT DER RATE STRAHLENINDUZIERTER TRANSFORMATIONEN UND NEZESSIV GESCHLECHTSGERÄINDER LETALE FAKToren Vom STADIUM DER Spermatogenese B5 DROSOPHILA MELOGYASTER (The dependence of the rate of radiation-induced transformations and sex-linked lethal factors on the spermatogenetic stage in Drosophila melanogaster). Z. indukt. Abstamm.- Vererbungslehre 21 (1960) 201-5. (In German, with summary in English)

Utilizing a dual-purpose stock of Drosophila melanogaster the dependence of radiation induced transformations and sex-linked recessive lethals on the stage of spermatogenesis was investigated and discussed. A formerly existing discrepancy in the dependence of radiation induced transformations on the stage of maturity of the irradiated germ cells is explained by differences in experimental procedure: besides an adequate subdivision of the brood pattern an excess of P-females in the ratio of 3:1 was necessary for obtaining the maximum sensitivity expected for immature germ cells. (aut.)

TRAUT 1900 - [1929]


Eggs of D. melanogaster were x-rayed totally or partially, the nucleus-containing anterior and the non-nucleated posterior halves being treated separately. Embryonic and post-embryonic mortality was registered, and dose-effect curves constructed. Killing of eggs by X-rays is total or anteriorly appears to be due to the induction of dominant lethals in the irradiated nucleus, whereas X-rays posteriorly kills the egg by damaging the cytoplasm. Irradiation of posterior halves with much higher doses induces recessive lethals, on account of their lower radiosensitivity. The method of irradiation of uncleaned eggs rather than of adult flies seems to offer some advantages in analyzing the mutagenic action of radiation, especially the indirect or delayed effects, dependence on O2 and other chemicals, and other problems.


The mutation rates obtained after irradiation (~1000 r of X-rays) of oocyte (fertilized eggs prior to first cleavage) were considerably much higher than those observed after irradiation of adult males. A modified Miller 6-1 method was used. The results are tabulated and their implications discussed.


When 10-20 min-old Drosophila eggs were irradiated with X-rays, the LD50 was 270 r, with an occurrence of 9,2% of sex-linked recessive lethals (tested by irradiating X-rays eggs from a cross between wild females mated with Muller 5-males). Irradiation in a nitrogen atmosphere instead of in air reduced these effects, the LD50 being 580 r and sex-linked recessive lethals only 2,5%. Nitrogen treatment before or after irradiation had no effect.


Mutant spermatozoa were given a rather low dose of X-rays (about 850 r) in order to obtain recessive sex-linked lethals at a frequency (1,9%) comparable with that (1,25%) with which they had previously been produced in spermatozoa by ultraviolet. Detailed cytogenetic analysis showed that 70% of these X-ray lethals included 11 to 12 cytologically visible chromosome changes. Allowing for the moderate difference in the mutagenic doses of the two agents, the gus changes appear to be produced more readily by X-rays
than by u.v. The present difference is not yet statistically secure, however. On the other hand, the apparent similarity in frequency of deficiencies at these comparable doses is unexpected. Although the material was carefully scrutinized for very minute deficiencies and inversions, none were found in either series. (from abstr.)


A number of lethals were produced, and examined cytogenetically and cytologically in order to determine accurately the relationship between point mutation lethals and lethals associated with different types of cytogenetically detectable changes in chromosome structure. A low (100 r) and a high (2000 r) x-ray dose was used in order to determine the dosage relationship of the lethals. The results are tabulated. At the high dose, most of the lethals are associated with structural changes than at the low dose. Thus, structural change lethals apparently increase at a greater rate than do point mutation lethals. Point mutation lethals more nearly agree with a linear relationship, while the lethals associated with chromosome rearrangements vary approximately as the 3/2 power of the dose.


Drosophila melanogaster males of a stock which has no visible genetic markers but inversions in the X-chromosome (F. P. Muller's "bac" stock) were irradiated with fast neutrons delivered by a cascade accelerator. The 3 doses given were equivalent in effectiveness (in terms of % of recessive lethals in the X) to approximately 500 r, 1000 r. and 2000 r of x-rays. The offspring of the different breeds was arranged to represent sperm that was irradiated in successively earlier stages of spermatogenesis. All mutations, visible lethal and lethals are being analyzed cytogenetically. A considerable number of mutations have already been collected. (from abstr.)


Newly emerged males of Aedes aegypti (L.) were treated with 2000-4000 r from x-rays or γ -radiation. Their progeny were bred to the F1 generation and examined for inheritable morphologic variation. Nine kinds of visible, viable mutations were isolated and are being maintained.


Through an analysis of the frequency of allelism of second chromosome lethals induced in D. melanogaster by chronic γ-radiation treatment, it has been estimated that the minimum number of loci capable of mutating to lethality under these conditions is 400 (37-716). (auth.)

(See also ASCU-990, Cold Spring Harbor Biological Lab., 5 p.)

1086 Wallace, B. MUTATIONS IN Males and females of the over number of experiments, in no different periods. The ten-fold increases linearly with dose of 2000 r at 35° while they develop of recoverable lethals in the (Paper presented at the 1950 in

* Wallace 1949 - [4687]

* Wallace 1951 - [4677]

1087 Ward, C. L., Alexander, M. L. DROSOPHILA MELANOGASTER A cytological study of x-ray-induced mutations to those mutations with some. The mutations at eight Alexander from irradiated spermatogonia showing two mutations, that of 73A of the left arm of the third modified by an earlier investigation mutations show a deletion of th. These three chromosomal abed third chromosome. (from abstr.)


Among mutations from mature spermatogonia, 23.2% with definite mutations which were lethals in tissues, 58.6% were lethals, mutations were point mutations sperm is higher than that for based on total genetic damage.

* Whiting 1960 - [3930]


Numerous x-ray-induced eye-color mutations (genotically variable) (genotically transparent). All of these induced characters is discussed.


Oyster white eyes and several re of heredity been in past rep. Drosophila paper, Pachystropogon
Wallace, R. MUTATIONS INDUCED BY CHRONIC RADIATION. (Abs.) Genetics 35 (1956) 696.

Males and females of the cer-1 strain of Drosophila melanogaster were subjected to chronic irradiation in a number of experiments. In one series, chronic x-irradiation was applied at approximately 100 r per d, over different periods. The sex-linked lethals in males were studied. The proportion of recoverable lethals increased linearly with dose for 20 d; there is no increase after that time. In a second series of tests, males and females carrying lethals-free second chromosomes were exposed continuously to γ-rays for 18 d (approx. 2000 r) at 0° while they developed from eggs to adults. A significant difference between the frequencies of recoverable lethals in the two sexes was found. Some further details and results are given.

(Paper presented at the 1956 meeting of the Genetics Society of America, Columbus, Ohio, 11-14 Sep. 1950)

Wallace 1956 - [1456]

Wallace 1957 - [1457]


A cytological study of x-ray-induced mutations has been undertaken to determine the proportion of point mutations to those mutations which are associated with various types of structural changes of the chromosome. The mutations at eight specific loci in the third chromosome, published previously, were obtained by Alexander from irradiated sperm and spermatogonial. A cytological analysis of the offspring of an individual showing two mutations, red and scarlet, reveals a deletion of approximately 20 bands in regions 72B and 72A of the left arm of the third chromosome. The deletion includes the region which has been assigned to this arm by earlier investigators but not that which has been assigned to scarlet. Analyses of other scarlet mutations show a deletion of the regions 72B and 72A and a translocation with the break in region 73A. These three chromosome abnormalities indicate that the scarlet gene is located in either 72B or 72A of the third chromosome. (From abstract)

(abstract of paper presented at the 1952 meeting of the Genetics Society of America, Iowa, New York, 8-10 Sep. 1953)


Among mutations from mature sperms which were studied, 53.8% were associated with no chromosomal aberrations, 25.8% with deficiencies, 8.9% with inversions, and 14.9% with translocations. Of these SS mutations which were lethal in the homozygous condition, 92.9% had no detectable chromosomal aberrations, 6.0% were deficiencies, 0.9% were inversions, and 15.2% were translocations. All spermatogonial mutations were point mutations but represented all viability categories. The genetic damage to mature sperm is higher than that for spermatogonial when the calculation of the mutation rate for mature sperm is based on total genetic damage. (From abstract)

Whiting 1950 - [390]


Numerous x-ray-induced eye-color mutations from wild type (dark brown) are reported in the chalcochid wasp Morlemilla vitricuspis (Walker). They range from dark red to "wavy" (dew of pigment and transparent). All of these induced mutations were obtained by irradiation of females. Their hereditary character is discussed.


Opine white eyes and several reds have been obtained in Morlemilla vitricuspis (Walker) and their method of heredity has been in part reported. Phenotypically similar eye colours have been induced in a parasite of Drosophila pupari, Pachyoponculus dactylinus. Rate of mutation is high in both species.

Maconia striatipes (Walker), also called Moromiella, is a chalcidoid-wasp parasite of blowfly pupae. Spontaneous mutation rate is very low but many eye-colour mutations have been induced by x-rays resulting in brilliant scarlet and in other reds, also in pigmentless eyes called opales. In the experiments described both pupae and adults of unmated females were exposed to 2000 r and the offspring haploid males bred and studied.

# Whiting 1953 - [1954]


The similarities and differences between two species of wasps, Moromiella and Pachycephalus, were studied. They belong to the same family but to two different sub-families. Both are parasites of dipteran eggs and, under the influence of x-rays, give rise to parthenogenetic offspring. A series of mutants responsible for eye colour is found in Moromiella. Two series of alleles are involved. In the same way x-rays may produce mutations in eye colour. Locus R appears to be homologous for the two species. The two sub-families appear to have had a common ancestor at the beginning. The first parasite preyed on a large number of species, the second on a more limited number.

# Whiting, A. R., Atwood, X.C. CONDITIONALLY DELAYED DOMINANT LETHAL MUTATIONS IN HABEROBRACON. Radiation Res. 9 (1955) 215, abstr. 16.

In the wasp Haberobracoon, unfertilized eggs develop normally to become haploid males; fertilized eggs become diploid females. Females which had stored eggs in the first meiotic metaphase were x-irradiated, and one-half of them were subsequently mated. The fertilized eggs had a much higher hatching frequency than the unfertilized eggs, however, adult survival did not differ markedly between the two groups. It appears that two classes of dominant lethal mutations can be induced: one class, comprising 80% of dominant lethal mutations, kills the eggs in a specific developmental stage whether the embryo is haploid or diploid. The other class comprises conditionally delayed dominant lethal mutations which result in death of diploid embryos at a later stage of development than haploids. Dominant lethal mutations of the former class only are induced when eggs are irradiated in the first meiotic prophase.


X-rayed wild-type females were mated to untreated males with peach eyes, a recessive at the R locus. Daughters produced were, therefore, wild-type unless a mutation occurred at this locus. Mutation rate could be studied at a single locus and mutant types with recessive lethal effect were recovered as well as viable. It has been shown that, within the limits of the data, this total mutation rate at the single locus R is high, being not significantly less than the rate for viabiles at all loci including R. Androgenic offspring, both males and females, were produced following irradiation of eggs. (from abstract, summary)

# Whiting et al. 1956 - [1957]

1095 Whittinghill, M. SOME EFFECTS OF GAMMA RAYS ON RECOMBINATION AND ON CROSSING OVER IN DROSOPHILA MELANOGASTER. Genetics 36, 4 (1951) 655-65.

γ-ray treatment of 4000 r given to adult D. melanogaster females altered crossover values in a regular pattern in meusa hemizygotes. Increases were greater, relative to controls, in the spindle attachment region in the middle of the 3rd chromosome, progressively lesser in each successive region furthest out, and negative in the two most distal regions. Great individual variations in crossover production after irradiation was shown by regular females, by inversion females, and by regular males. The changes might have originated in meiotic or in gonial cells. The results are discussed in some detail. The crossovers induced in 14 of 19 treated males showed an even greater non-random distribution from spermatogonial crossing over. A new crossover-selector system of testing was employed. (See also earlier abstract in Genetics 35 (1950) 10-1 and CRNL-817, Oak Ridge National Lab., Tenn. 1950, 43 p.)

1096 Whittinghill, M. MISSION OF UL. shrut. 48.

1097 Whittinghill, M. 48 (1956) 189-2

X- and γ-rays as to increase c in males and the chromosome was some detail.

# Wolff and Linde

1098 Yamas, A. F., DROSOPHILA. IC

Newly emerged x-gens of 960, irradiated males eggs laid within dissected as low percentage of in other species, the trend of sex in D. melanogaster germ cells than seems most prob chromosome are physiological ag (Abstract of page 8-10 Sep. 1956)

1099 Yamas, A. F., Proc. 46 (1956)

Newly emerged, treated in groups singly after irradiation allowed to emerge; 80% of dominant lethals, at the aberrations found reported. The p but a larger prop

1100 Yamas, A. F., Nebraska Univ.

1101 Yamas, A. F., DROSOPHILA robusta mated. By formation of pop in the progeny, it males aged 17 d ability of chromosome over the responsible. Th
1096 Whittinghill, M., Giles, A.R. AN INFLUENCE OF X-RAY INDUCED CROSSING OVER ON THE TRANS-
abstr. 48.
45 (1955) 191-200, Suppl. 2.
X- and y-rays are able to induce crossing over where it does not occur spontaneously in Drosophila males,
and to increase crossover production by Drosophila females of widely different constitutions. The induction
in males and the increases in females show similarities as to time of appearance of crossovers, region of the
chromosome usually affected, and lack of randomness. The implications of the results are discussed in
some detail.

1098 Wolf and Lindley 1950 - (1958)
1099 Yandell, A.F. X-RAY-INDUCED CHROMOSOMAL ABBRERATIONS OF DOMINANT LEATHALS IN
DROSOPHILA ROBOCATA. Genetics 22, 4 (1950) 338.
Newly emerged males and females were separated for 10 d prior to treatment of the males with doses of
x-rays of 500, 7500 and 10,000 r units. The percentage of dominant lethals induced in the sperm of the
irradiated males was determined by comparison with non-irradiated controls of offspring resulting from
eggs laid within 10 d after irradiation. Some of the progeny of the groups treated with 5000 r units were
dispersed as larvae for the detection of induced chromosome aberrations. At this dose, a much smaller
percentage of induced chromosome aberrations was recovered than anticipated from published results with
other species. Slightly higher values for induced dominant lethals were obtained in all groups, although
the trend of reduction of offspring number closely parallels that in other species. Since it has been shown
in D. melanogaster that dominant lethals are induced more easily in sperm of aged males and immature
germ cells than in sperms which has just matured, with a corresponding decrease in visible aberrations, it
seems most probable that both the higher values for dominant lethals and the lower rate of recoverable
chromosome aberrations in D. robusta are due to different responses to irradiation of germ cells of different
physiological age.
(Abstract of paper presented at the 1952 meetings of the Genetics Society of America, Ithaca, New York,
8-10 Sep. 1952)

Proc. 38 (1952) 16.
Newly emerged Drosophila robusta males and females were separated for 10 d, after which the males were
treated in groups of 20 to 55 with doses of x-radiation ranging from 5000 to 10,000 r, and placed immedi-
ately after irradiation with equal numbers of females. The offspring resulting from eggs laid within 10 d
after irradiation were either dispersed as larvae for salivary gland chromosome smear preparations or
allowed to emerge from the pupae for determination of the frequency of dominant lethals. The proportion
of dominant lethals, as determined by counts of emerging flies in the controls as compared to treated groups,
is greater at the higher doses than has been reported for any species previously studied. The percentage
of aberrations found indicates that a much smaller proportion is recovered in this species than in any previously
reported. The present data suggest that aberrations are produced with equal frequency as in other species,
but a larger proportion are lethal to the individuals receiving them.

1101 Yandell, A.F. THE EFFECTS OF X-RAYS ON THE CHROMOSOMES OF DROSOPHILA ROBOCATA.
1102 Yandell, A.F. X-RAY-INDUCED DOMINANT LEATHALS IN DROSOPHILA. Genetics 22, 1 (1956) 558-64.
Drosophila robusta males, aged 10 d or 17 d, were exposed to 6 (control), 2500 or 5000 r of x-rays and
mass mated. Eggs were collected at 24-h-intervals for a period of 10 d, and counts of egg fertility,
formation of pupae, and emergence of adult progeny were obtained. Values for induced dominant lethals
in the groups aged 10 d are similar to the values for D. melanogaster at corresponding dosage. Sperm of
males aged 17 d, however, exhibit a greater sensitivity, agreeing with the hypothesis of a greater break-
ability of chromosomes in sperm of aged males. A gradual decrease in the number of dominant lethals was
noted over the 10 day-period following irradiation; it is suggested that restitution of induced breaks is
responsible. The fact that this increase in fertility is noted throughout the 10-d period over which egg

201
were collected, with no subsequent drop as noted after 7 d with D. melanogaster, may indicate that physiological processes involved in spermatogenesis occur at a slower rate in D. robusta than in D. melanogaster. (auth.)

1108 Yaden, A. F. AN INFLUENCE OF AGE AT TIME OF X-RAY TREATMENT ON THE INDUCTION OF MINUTE EFFECTS IN THE SPERM OF DROSOPHILA MELANOGASTER. (abstr.) Genetics 59 (1964) 1002.
Adult males of D. melanogaster (Oregon-R) were exposed to 4,020 r of x-rays at 1, 7 or 13 d after eclosion. The occurrence of dominant Minute characteristics believed to be due to small deletions, was observed in the progeny. The frequency was highest in the oldest group, intermediate in the middle group, and lowest in the youngest group. The mean percentage of Mérates on successive days after irradiation showed a characteristic pattern in each age group. Curves of these values exhibit a striking similarity in form to those plotted for induced dominant lethals (from the data of Liston, Hereditas 39 (1952) 99), suggesting that similar mechanisms are responsible for both dominant lethals and Mérates.

Groups of adult Drosophila melanogaster (Oregon-R) males were aged in the absence of females for various periods after eclosion. Twenty-four hours prior to irradiation, each group was divided into halves, one of which was placed with an excess of females and permitted to mate ("pre-mated"), the other half remained unmated. Just before irradiation the pre-mated males were separated from the females (which were discarded), and all groups were irradiated simultaneously with 4,020 r of x-rays and mated immediately to Muller-5 females. Care was taken to test only progeny resulting from sperm used within twenty-four hours after irradiation. Sex-linked recessive lethals occurred in substantially the same proportion regardless of age among all groups of pre-mated aged males and non-aged males (0-1 d old at irradiation). However, the proportion recovered from groups aged 7 d or more and not pre-mated was significantly greater. These data are in agreement with previous studies showing higher incidences of radiation-induced dominant lethals and Mérates occurring in the sperm of aged males. In addition, it is clearly indicated that some sperm storage must occur in Drosophila males, and that the increased susceptibility to irradiation is related to the age of the mature sperm rather than the age of the male at treatment.

Mature sperm of male Drosophila melanogaster were exposed to 2000 rads of fast (1-8 MeV) electrons from a Van de Graaff accelerator, given at rates ranging from 210 rads/min to 6600 rads/min. The amount of genetic damage was assessed by measurements of the frequency of induction of sex-linked recessive lethal mutations and dominant Minute effects. No significant differences attributable to radiation dose rate were found between treated groups. The dose-rate effects reported by other authors using x-rays are not found with fast electrons. Possible reasons for the disagreement are discussed. (auth. summary)
(A 170-page report, USNRL-TDR-117, was published in 1958)


1-9-9 INDUCED STERILITY

Books

Chapter 1 on spermatogenesis, chapter 2 on embryology, and chapter 6 on internal anatomy are especially valuable to workers interested in insect sterilization.
May indicate that

In D. punctata than in D. melanogaster,

---

GENT ON THE INDUCTION OF

(1954) 1002.

One third to one half or 14 d after escaction.

small deletions, was observed in males in the middle group, and lower
days after irradiation showed a

striking similarity in form to the females (35, 34, 31), suggesting

Flies

INDUCTION OF SEX-LINKED

the absence of females for various
groups of males divided into halos, one of

them called "mutant"). The other half remained

female which were always and mated immediately to

or half the number of males of the same group were used as controls. The

irradiation of spermatozoa was done under the same conditions as in the

section. The irradiation was performed at a dosage of 1000 r, and the

spermatozoa were then transferred to females which were previously

infertile. The eggs were then cultured under standard conditions and

their viability was determined.

---

FEMALE ELECTRONS IN

at the levels of 1-2 MeV and 4000 rads/min. The amount of

radioactivity in the system is increased by the exposure to radiation. The

radioactivity is directly proportional to the intensity of radiation.

---

VARIUS SYSTEMATIC GROUPS

1. (In Japan)

2. (In Japan)

---

VARIUS SYSTEMATIC GROUPS

---

Carney, G. C. DIFFERENTIAL RESPONSE OF MALE AND FEMALE ADULTS OF TROGODERMA GRANARIUM EVENTS TOWARDS STERILIZING DOSES OF GAMMA RADIATION. Nature 159, 536-5. (1955)

Adults of Trogoderma granarium were irradiated with sterilizing doses of gamma radiation (administered from a Cs-137 source at 500 rads per minute) to study the differential response of the male and female. Results show that a dose of 1 x 10^{12} rads is sufficient to sterilize only the females of the species. The males are able to mate and produce fertile young at doses as high as 10^{18} rads which is three times that required to sterilize the females.

---


Calliptima americana males were sterilized by irradiating young adult flies, but it was found that some flies had a shorter life span than normal flies. This was due to the increased dosage of radiation used.

---


Experiments were aimed at developing procedures for sterilizing large numbers of screw-worm flies. Calliptima hormosia males were irradiated with different doses of gamma rays, exceeding 1000 rads, and the effects on fertility was noted. It was found that a dose of 1500 rads was sufficient to sterilize the males but not the females.

The effects of γ-radiation on insects infecting cereal commodities were investigated. Tests were carried out on insects of 27 species, and a Co-60 source that provided a dose-rate of 8000 r/h was used. The effects of different dosages on adults, larvae, and pupae were discussed in terms of mortality, development, and fertility. A high level of sterilization was obtained at 68,000 r.

Cowell and Morris 1980 - [69].

Cowell and Morris 1980 - [997].


An investigation was made of certain aspects of the biology and ecology of the moth in an insulated mill to appraise the suitability of sterile male release for the eradication of this species. A. kühnelii was concluded to be an unsuitable species for control by this technique.


Boll weevils (Anthonomus grandis) adults, pupae, and eggs have been exposed to various doses of γ-radiation. Male boll weevils were sterilized with a dose of about 15,000 r; however, extremely high mortality resulted.


In the laboratory studies on the effect of gamma radiation on Anopheles quadrinaculata Say, it was found that RHESO 65 to 12,000 r applied to the pupal or adult stage were required to cause complete sterility. Irradiated females mated to unirradiated males produced no eggs, whereas unirradiated females mated to irradiated males produced a normal number of eggs but none hatched. When irradiated males were introduced into caged populations of normal males and females at ratios of 4:1 or less, usually no reduction in the total number of viable eggs was produced, but at ratios of 0.5:1 and 0.1:1 there was a reduction of about 80%. The doses (g) required to cause 50% and 100% mortality in 48 h were for eggs, 1500 and >11,000; for larvae, 40,000 and 120,000; for pupae, 22,000 and 48,000 (auth.).

(An abstract was published in Bull. ent. Soc. Amer. 4, 9 (1958) 102, abstr. 277 under "Reduction in the reproductive rate of Anopheles quadrinaculata caused by the presence of irradiated males in a normal population").

Dent and Amy 1956 - [1276].


Permanent sterility could be induced in females by feeding above 250 μc Po-210 of racemic mixture. At values below 200 and down to 175 μc Po-210 temporary sterility was induced, starting about the 10th d. Relatively intense x-rays of 2500 r/min induce permanent sterility above about 4500 r. Below this dosage, down to 3000 r, temporary sterility may be expected. The number of eggs deposited is negatively correlated with the dosage. The onset of sterility (4th-7th d) occurs earlier than after Po-210. Oosper, and number of eggs laid are influenced by starvation. Fraculation and lethality experiments demonstrate that the manner in which stimulations from radiation are distributed in time is important when sterility is considered. Data on egg production and hatchability following exposure to various doses of x- and β-radiation are presented and factors influencing the induction of sterility are discussed.

Cowan and LaChance 1956 - [461].

Cowan et al. 1956 - [583].
EFFECTS OF GAMMA RADIATION

The effects of gamma radiation on various organisms have been investigated. Tests were carried out with 6000 r/h used. The effects on mortality, development and reproduction were studied.

JOSEPHS AND CORNWELL 1958 - [1145]

sterility and development were studied. A. ibidinae was used as a test species. It was found that a 25% decrease in the studied males in a normal population was observed after exposure to 2500 r/h of gamma radiation.


The determination of dominant lethals in D. melanogaster is based upon egg hatchability measurements. Using techniques, the mating of treated males to a series of virgin females, permits the determination of irradiation rates in sperm that are successively younger at the time of irradiation. However, there is no direct way to D. melanogaster to distinguish between eggs that have failed to hatch because they remained unfertilized and eggs that have failed to hatch because development of the embryo has broken down as a result of an induced genetic event. For this reason a cytological and genetic study paralleling the genetic determination of dominant lethality was carried out for three broods of eggs following the irradiation of a group of adult males with a 2000 r dose of x-rays. The data that obtained provide evidence for the fact that in both the control and irradiated series unfertilized eggs contribute significantly to the dominant lethality rate as determined by hatchability tests.


A sample of eggs from each dominant lethal group was pooled and sexed for evidence of sperm entrance. It was found that unmated eggs contribute significantly to the dominant lethality rate based upon hatchability tests. The present report presents data on sterility obtained when the x-ray dosage and the mating intensity (number of females per male) are varied. Three x-ray dosage levels, 500, 1500 and 2000 r units, were used. At each dosage level three broods each of one female per male, two females per male, and three females per male were handled. Each male was permitted to mate over a period of nine days, three days per brood. The data show that sterility (failure of sperm to enter an individual egg) increases with dosage and is highest in the third brood, but brooding itself is no cause of sterility. The high sterility observed in the treated third brood fertilizations (sporae that were spermatozoa or younger at time of irradiation) seems to be a combination of factors produced by the radiation and the utilization of sperm.

See preliminary study by Kaplan, Tanaka and Yamasaki (Genetics 41 (1956) 649).


The dosage was 7500 r x-rays. Infection studies showed that in the first week after emergence from the pupal case the irradiated males could inseminate as many females as could the normal males when both types were isolated with a maximum number of normal virgin females. No larvae developed from matings.
between irradiated males and normal females, even after 3 weeks of matings. This dose produced complete sterility, with no recovery of fertility in the male. The dominant lethal effect in the sperm was probably due to induced chromosome breakage. The irradiation caused permanent genetic damage to both spermatogonial cells and spermatocytes, as well as to spermatids and sperm, as evidenced by the presence of stickiness and bridge formation in all of the dividing cells seen, the great number of degenerating nuclei observed, and the fact that there was no apparent increase in the amount of sperm in the testes after irradiation. The bridges seen in the dividing cells could have been due to re-combinations, or chromosome stickiness, or both.

* King 1955 - [289]
* King (unpublished) - [2145]
* Kolping 1960 - [222]
* LaChance 1955 - [1146]
* LaChance 1960 - [1386]
* Macleod 1960 - [2500]
* Melville 1956 - [1250]


Les charançons, Calandra granaria L., âgés de 15 à 30 jours après émergence, ont irradié à 500 r/min. L'auteur étudie l'influence de doses croissantes (0-1800 r) de rayons x sur la reproduction; l'effet stérilisant apparaît qu'à partir de 2000 r. La dose minimum obstruisant le stade vitel 1600 r.

* Nicholas & Wass 1959 - [1818]
* Port 1958 - [1444]
* Roble 1958 - [985]


The action of x-rays (doses from 30000 - 800000 r) on the elongated mite Tyrophagus putorius was studied in 10 series of tests. An exposure to a dose of 60000 r destroyed 86% of the mostly younger (1-3 o old) eggs; 80000 - 800000 r resulted in sexual sterilization of larvae, nymphs and adults; at the end of 3 weeks, exposure to 300000 r had produced lethal effects on all metamorphosing stages. The elongated mite is 20 to 30 times more resistant to ionizing radiations than other cereal pests. Doses above 100000 r have an adverse effect on the mowing quality of seeds and can only be used for the decontamination of cereals stored as food supplies. (From Rathauny Ratanova Zhurnal Biologii 1 (1959) 781)


Review article. Interest in whether the effects observed in the laboratory on egg development of the cabbage worm (Mamestra brassicae, L.) are similar to those observed in nature is described. The results suggest that the effects observed in the laboratory on the effects of x-rays on the egg development are not the same as those observed in nature.
I - C Effects on Development

8 C - 1 SURVEY ARTICLES


Review article. Interest lies in determining whether x-rays influence the respiratory process and, if so, whether the effects observed can be attributed to direct injury of the respiratory mechanism of the embryo or to secondary effects from interference with development. The effect of x-rays on hopper eggs and embryos during diapause are tabulated, also the respiration of developing eggs exposed to different environmental temperatures after irradiation. Table 8 gives data on respiration of developing embryos after x-irradiation in vitro with 2040 r. Graphs illustrate earlier work (Fig. 2): respiration of control and x-irradiated diapausing embryos in the presence of 2 x 10^{-6} M and 1 x 10^{-6} M, 5,6-dinitro-2-furfuraldehyde and 1 and 2 d after irradiation. The effect of irradiation on hatching of eggs is tabulated. Except for the period immediately after irradiation, respiration in the embryo, especially during diapause, appears to be remarkably resistant to x-rays. For the dosages used they usually develop normally to hatching. The lethal effects are expressed in the inability of the embryo to hatch. (Data on x-ray effects are also compared for studies on sea urchin gametes, frogs, and a variety of other biological specimens).


This paper was presented as a symposium of the Assoc. of Applied Biologists. The main insects considered were Lycus powder-post beetles (L. brunneus Steph.), the house longhorn beetle (Hylotrupes bajulus L.), the Death-watch beetle (Xestobium rufovillosum Deg.), and the common furniture beetle (Anobium punctatum Deg.). The effectiveness of preventive treatments, problems of eradication, fumigation and sterilization of timber by heat were discussed, and also radiation treatment, the last in a still experimental stage. Insects in different stages of development, and selected samples of wood were exposed to γ-rays from a Co source at Harwell, and the material subsequently examined and used for breeding experiments. The general results are discussed. While information on the effect of irradiation on larvae is incomplete, experiments with Lyctus indicate that resistance increases with age, and that completion of development can be prevented. Much more data is required before such a method can become applicable commercially.


Textbook. Section 3 of part VI deals with radiation effects on insect embryos, taking Drosophila as example (p. 209-13). Subsections are devoted to radiosensitivity, analysis of lethal effects, the variation of different
degrees of damage with age at the time of radiation, and with dose levels, partial irradiation, the dose-effect relation, the RBE of different kinds of radiation, gaseous reactions to irradiation including radiation sensitivity and its variation with stage in development and radiation-induced phenoanomalies. Over 1000 references.


The use of ionizing radiation usually required 25,000 - 50,000 rads to destroy insect eggs; 50,000 - 600,000 rads will be lethal to all insects. A dose of 25,000 rads prevents development of insects from one metamorphic stage to the next, and also prevents reproduction in the female. The dose selected applies equally to all insect species. The determining factor in application of radiation is the effect on the quality of the product. The effects of weight, size, yield and sales are described. The species studied were the confined flour beetles (Tribolium confusum), the yellow mealworm (Tenebrio molitor L.), the wax-processed grain beetles (Cryptophlebia uralentis L.), the lesser grain borer (Culeorrhacia dominica F.), and the cigarette beetles (Lasioderma serricorne F.).

1129 Peredchsky et al. (1967) 1969 - [1518]


This bibliography contains 2150 abstracts covering all phases of the biological effects of radiation. The abstracts are arranged in sections covering general information, effects of internal radiation, effects of external radiation, effects of internal radiation and metabolism, and toxicity of internally deposited radionuclides. Radiation, radiobiology, mechanisms of radiation effects, and effects of radiation on growth and development, genetics, and biology. Numerous early references, relevant to the present bibliography, are included.


Review article on radiobiology. Some reference is made to work on insects (Neosola, Habrobotra). The article is useful as a review of the field rather than in terms of having any exclusive bearing on entomology. It deals with models for primary radiation damage (direct and indirect action), and modified direct action models, some factors which influence radiation response (radiation parameters, environmental factors, post-irradiation, physical and biological factors), some effects of radiation (cytological effects, muscle, acid synthesis and growth, mutagenic, biochemical and miscellaneous effects), and with some aspects of cellular radiosensitivity, such as radiobiological radiobiology, target theory, etc.


Very general review article. Applications of ionizing radiation are included.


Since this was thought desirable to use flies having at least one marked chromosome, multiple mutant X-chromosome D. melanogaster stocks were used. Preliminary work indicated that relatively low doses would yield appreciable results and that the observation should be limited to the number of eggs laid. The results suggest that the 5000 r treatment, as compared with untreated controls, did produce a striking effect. The 5000 r treatment, however, seemed to reduce the fecundity of the females appreciably. (from abstr.)


Experiments were designed to measure certain effects of x-rays on D. robusta females. The variables were treatment, age (at the time of treatment) and days (following treatment). The effects were observed on fecundity (number of eggs laid) and fertility (proportion of eggs cultured to complete a particular stage of development). 0 (sufficiently reduced fertility) was nearly proportion of the 5000 r series. variable recover
Effects of X-rays on Drosophila Robusta Females.

Groups of ten virgin B. robusta females, 10 or 17 days old, were either exposed to x-rays (1500 or 5000 r units) or served as unexposed controls. Immediately after treatment each female was placed in a vial with two males. For 10 days after treatment, observations were made on fecundity and fertility. The number of eggs laid was reduced by x-rays. Even though total egg production was reduced by 60%, the reduction was less than 1/2 as great as in the 5000 r control series. Dissection of the females on the 21st day showed the ovaries of these females which had been exposed to 5000 r x-rays to be considerably shriveled. There were no detectable differences between the ovaries from females of different age groups treated alike or between the 2500 r and control groups. The reduction in egg-hatch by x-rays was nearly proportional to the dose for the first 10 days following treatment. From then on, variable recovery was exhibited. A generally higher rate of x-ray induced dominant lethality was noted than that reported by Yandell (1957) in his study of B. robusta males. Whereas Yandell found a greater reduction of dominant lethality in older flies compared to younger ones, there was no such effect of age when females served as the x-rayed parents.

Bertz, R. Experimentelle Untersuchungen über den Einfluss von Körntentraumen auf die Embryonalentwicklung der Heringen. (Study on the effect of x-rays on embryonic development in this species). Rinn Arch. Entwickl. Organ. 162, 4 (1950) 524-54. (In German)


Females of the silkworm Bombyx mori L. lay all their eggs at one time, and the eggs of egg maturation are rather firmly related to the developmental stages. Females, as well as males, were irradiated by x-rays (Therapeutic Philips Apparatus, 50 KV, 2 ma, 850 r/min) at 3rd and 5th larval stage and early and late pupae with 2000 r, 5000 r, 1000 r, and some with 8000 r, by varying the length of exposure. The irradiated females were crossed with untreated males of the same egg-breed, the males with untreated females of another egg-breed of the same sex. The number of laid eggs (fecundity) and that of hatched larvae (fertility) were recorded. Above 2000 r fertility decrease is higher among the females treated at the fifth larval stage and early pupae than among the irradiated late pupae. These effects show that the sensitivity of the oocytes is higher during the 2nd period of growth than during vitellogenesis. Fertility, which can be considered a test for induction dominant lethals, is more affected in later stages of oogenesis than in earlier ones, which means that metaphase chromosomes are more sensitive than prophase ones. These results are in agreement with those obtained in Drosophila. A stage of oocyte growth particularly sensitive to x-rays is the second period of growth when nurse cells produce large amounts of RNA which is used for the synthesis of structurally homogeneous cytoplasm in the oocytes. X-ray treatment probably interferes with RNA production and/or RNA utilization. (From abstr.)

Greech, D. S. The quantitative alterations in Maleconcan Fecundity Induced by Co60 Exposure. Radiation Res. 9 (1958) 128-4.

For γ-ray exposure, wasps held in gelatin capsules were lowered into a box of wasps containing a wooden nest box. One facility delivered 3000 r/h, the other delivered 1400 r/h. Graded doses from the former demonstrated that 11000 r was required to halt egg production. This is twice the dose required from a 250-kv generator adjusted to deliver x-rays at the same rate. With the less intense γ-source, 15,000 r had to be delivered to obtain the results desired. This latter source has been followed for four years. Increasingly larger exposures have been necessary to halt egg production with the γ-source, suggesting that higher production with the γ-source may be due to the higher intensity of the radiation.

The number of eggs laid by the treated females was significantly reduced. The effects were observed on the eggs to complete a particular stage of development. 0 (control), 5000 and 5000 r of x-rays were used. Treatment females with 5000 r considerably reduced fertility, even sterilizing many of them. The reduction in fertility (as measured by egg-hatch) was nearly proportional to the dosage. The 2500 r series had a reduction of fertility nearly half as great as that of the 5000 r series. This was true, however, for the first 10 days period of observation only. From then on, variable recovery was exhibited.
involving x-rays from an ingested source. Combinations of 50/75, 50/50, and 75/25, set up from the definitive dose approach, did not prove additive in halting *Habrobracon* egg production.


Definitive doses of a combination of x- and y-rays and of y- and y-rays are not additive in the induction of permanent cessation of insect egg production. Also, hatchability, used as further assessment of radiation damage, excludes predominance of one component. Recommendations for radiation test or control should be based upon the component determined predominant by biological experiments, rather than on total dose. The study was carried out on *Habrobracon*. (auth.)

1139 Goshch, D. S. **PROTECTIVE EFFECTS ON FECUNDITY AND FERTILITY FROM FEEDING CYSTEINE AND GLUTATHIONE TO HABROBRACON FEMALES BEFORE X-IRRADIATION.** *Radiation Res.* 23 (1960): 166-84.

Protective effects on oviposition and egg hatchability were shown for both cysteine and glutathione when fed to female wasps before irradiation. The effect, detected only during a period of 3 to 12 days after treatment, was therefore limited to cells in transition from oogenesis to differentiated trophocyte-ectopye units. Transition involves completion of a series of mitotic divisions. Although a direct effect on cell division may be reflected in the number of eggs produced per unit of time, a response delayed until the onset of embryonic development implies alteration in the genetic rather than the hysteretic mechanism. Indeed, both the effects on oviposition and egg hatchability could trace back to modifications of chromosomal damage, immediate and delayed. (auth. summary)


The mortality in oocytes caused by x-rays is considerably greater in dehydrated females than in normally hydrated ones. The rate of oviposition is highest amongst untreated females, reduced amongst those receiving a fractionated dose of x-rays, and still further reduced when irradiation takes the form of a single dose. (auth.)


The biology of *G. nasutus* is given, and the effects of irradiation on both the adults and larvae are discussed. There was no reproduction when 2nd instar larvae were irradiated with doses of 4000 r or greater. A dose of 4000 r to 2nd instar either killed the larvae, or delayed development with the resulting adults being badly deformed. Irradiation of adults with 3000-5000 r halted reproduction, but did not affect the length of the expectancy. (auth.)


Oregon-R males were tested in day-by-day sperm samples for dominant visible and hemizygous sex-linked mutations, fecundity (number of offspring produced), and courtship behavior after exposure to cobalt-60 y in the 100 to 165 kev range. Tests totaled 42,284 X-chromosomes and 212,111 flies. Mutations were most frequent after irradiation during meiosis and spermiogenesis in low doses. Only sperm and genital cells subsequently produced adult flies after exposure to 5 kev and 10 kev. After 500 r fecundity was reduced chiefly in cells in late mitosis, and in earlier and later stages with increasing doses. Reduced fecundity may not be due to the kind of mutation detected here, but both effects may contribute to increase the frequency of mutations recovered, particularly from irradiated meiotic and spermiogenic cells. Males receiving 500 r might contribute more mutations to a population's gene pool than competing males after a substantially higher dose. (auth.)


The results suggest (1) that the extent of the fecundity effect of radiation depends upon the genetic constitution of the male, (2) that the fecundity effect may be chiefly non-genetic and (3) that it occurs, after low radiation doses, at a stage in development prior to the genitalia. (auth.)

1144 Jeffries, D. L., Cornwell, P. I. **DOSES OF GAMMA RADIATION.**

Preliminary work is reported on the sterilization of *Drosophila melanogaster* males by radiation. Preliminary work is reported on the sterilization of *Drosophila melanogaster* males by radiation. (auth.)

1145 King, R. C. **STERILITY AND DROSOPHILA.** *E. melanogaster* males were irradiated with 4000 r to treat the same manner, i.e. only 50% of the initial frequency of chromosomal aberrations. The first generation males were killed as they appeared, and 60% of the sex-linked productivity of females from 4 were 16-cell cytons at the time polyplody time. (auth. summary)

1146 Kubin, A. F. S. **THE RESPONSE OF X-RAYS.** *Z.*

D. melanogaster males were irradiated with 4000 r to treat the same manner. The frequency of chromosomal aberrations was increased as the dose was increased. The frequency of chromosomal aberrations was decreased as the dose was increased. (auth. summary)


Male silkworms were fed with a mixture of *Drosophila melanogaster* and the results suggest that the radiation effects were due to the irradiation of the female parent. (auth. summary)

(-An English translation of the Japanese paper is published in *Science*)

"An English translation of the Japanese paper is published in *Science*."

270
radiation doses, at a stage in spermatogenesis earlier than the time of highest recovered mutational effects, possibly near or during the primary spermatocyte stage. (From abstr.)


Preliminary work is reported on recovery to lethal and sterilizing effects of radiation examined on developmental stages, using 5 fractions of γ-radiation from Co-60. Single doses of 4012 rads were given, when larvae grew into very few adults, or 3 fractions of 858 rads each at 1 min to 10 min intervals. Intervals of up to 8 d were tested. The existence of a recovery process, and effects on the production of progeny are discussed. The efficiency of direct irradiation of infected products could be seriously jeopardized by the use of repeated doses if intervals between them exceed a few minutes. The increase of longevity, on the other hand, obtained by the use of fractionated doses at daily intervals, could considerably increase the efficiency of insect control by the release of sterile adults, provided permanent sterilization was achieved.


Sex-linked recessive lethals were recovered from successive batches of eggs laid by female D. melanogaster irradiated with 4000 r of x-rays. While the initial frequency of lethals is identical to that of males treated in a similar manner, there is an immediate linear decline in lethal frequency which reaches a value only 65% of the initial frequency in eggs laid 7 to 10 d after irradiation. The decline in frequency is taken to represent the elimination in immature germ cells of induced lethal effects belonging to the class of chromosomal aberrations. The frequency and/or fertility of irradiated females is greatly reduced for the first 4 days after treatment. A rise in female productivity occurs between days 4 and 5. After a week has passed the productivity of treated females is almost normal, although the eggs produced by the females contain 60% of the sex-linked lethal frequency of eggs produced immediately after irradiation. This rise in productivity of females from 4 to 5 d after treatment is explained by assuming that the eggs laid at this time were 16-cell cysts at the time of irradiation and were resistant to irradiation in much the same fashion as is polytene tissue. (Auth.


D. melanogaster males were irradiated at various stages of pre-imaginal development, and mutation rates were compared between flies from different age groups, and between sexes from the same age group. The findings were correlated with observations on germ cell development in the larval and pupal stages. Sensitivity to the mutagenic effect of X-rays is low in all metamorphic stages. It increases suddenly and dramatically with the onset of meiosis, remains stationary through meiosis, and subsequently increases again up to a peak in the late spermatid stage when transformation into morphologically mature spermatozoa is taking place. This stage provides sperm for the first brood from males treated at about the middle of the pupal period, and mutation rate for a given dose of X-rays is about 4 times as high in mature sperm and about 12 times as high during meiosis. Subsequently, mutation rate drops again gradually to the level characteristic for mature sperm. Germinai selection cannot account for any of these changes, but it may be the main cause for the slight increase in response which occurs during spermatogonial development. (Auth. summary)


Silkworms were fed with NaHCO3, and the percentage of infertile eggs resulting from subsequent matings was determined. Exposure of 3 h to 5400 r of γ-rays from a Co-60 source gave rise to similar values for infertile egg percentages. Radiation-induced dominant lethal eggs reached a peak at the mid-stage of the 8th instar. A predominance of aneuploid spermatozoa below a certain level is considered to be responsible for infertile eggs. Abnormalities in metaphase chromosomes also appear to have some bearing on the emergence of dominant lethal eggs. An anatomical study was made...

* An English translation of this article under the title of "Stages of developmental variation in radiation susceptibility of the silkworm seminal gland especially low hatching rate, and its histocytological and biochemical proof" appeared on p. 1235-1312 of ARC-to-44092.
of the genital organs, and the effects of irradiation on nucleic acid content investigated biochemically. Autoradiography was used throughout.


Male silkworms were subjected to 3600 r of y-rays from a Co^60 source at the beginning of the (2nd), middle (5th) and end (7th day) of the 6th instar. The percentage of unfertilized eggs and of continuous lethal eggs induced by y-rays were determined. Biochemical and histological studies of the irradiated tests, with special reference to nucleic acid metabolism were also carried out. In other experiments, P^32 was made available to larvae by feeding Na^15OHPO_4. Phosphorus specific activities in DNA and RNA could be measured by using Na^15OHPO_4 as a tracer. The rate of occurrence of unfertilized eggs and dominant lethal eggs was found to be dependent upon radiation sensitivity in the different stages of spermatogenesis. The mechanisms responsible for these phenomena are discussed.


The effect of delaying the period of observation on induced sterility was investigated from irradiation studies on the parasitic wasp (Aphidius). Egg production curves are given for groups having oviposition delayed for various times after irradiation, all having received 3400 r y-rays expected to produce permanent sterility. The replacement of eggs caused by delayed oviposition is considered a valid interpretation of the trend shown in the curves, and also the increased hatchability. The data (days 2-4 post-irradiation) indicate that radiation (or positional delay) favors deposition of fewer non-viable eggs. The hatchability data for days 9-20 suggest that, with retention of eggs, fewer damaged oogonial cells survive differentiation. However, egg production begins immediately, most damaged gametes complete the meiotic stage down the ovaries and are oviposited. Delay in egg laying therefore affects hatchability during the entire reproduction cycle.

LaChance 1958 - (1959)

LaChance 1958 - (1957)


A single irradiation at 5 x 10^8 and also at 10^7 rad gamma radiation resulted in an increase in the number of eggs laid and hatched by the flour mite, Tyrophagus farinae. In contrast, irradiation at 5 x 10^8 rad significantly reduced the number of eggs laid and hatched, and a dose of 10^7 rad apparently sterilized the population. (NSA 18, 10011, 1958)


Young adults of two species of flour beetle (Tribolium confusum and T. castaneum) were subjected to 4 mixed doses of x-rays (2000, 3000, 4000 and 5000 r). Within each dose, the beetles were further partitioned, so that in one set only males received irradiation, in another only females, and in one, both males and females. The number of eggs laid ("fecundity") and larvae hatched ("fertility") was counted every 5 days until the females died. Reproduction by non-irradiated controls was also followed in precisely the same way. The experimental design thus discriminates these components: differences between species; fecundity from fertility, the effect of potential aging, irradiation from non-irradiation, the influence of dosage intensity, and the sexual pathway through which reproduction is affected. The major conclusions drawn were as follows: (1) There are differences between the two species in fecundity and fertility when neither, as well as when both x-ray exposed; (2) fertility is more affected by practically all components of treatment than is fecundity; (3) the relation of increase in dosage to decrease in reproduction is essentially linear; and (4) irradiation, at the levels given, does not appear to reduce adult longevity.


Three studies were exhibited at the laboratory meeting of the Royal Soc. Trop. Med. Hyg., March 21, 1957 to show the prevention of ovarian development in C. moritziana by irradiation of the pupal stage with y-rays from an activated Co-source (Hawaii) sterilization of males by the same tax.

Potts 1957 - (1959)

Tenzori, L. A., Stabler, N. A. EGGS OF ADEO AEGYPTI BIO. Studies were undertaken to evaluate Aedes aegypti. It has been shown males which had been exposed 8 with doses of 0.1 discards in excess of 2600 r, as Egg batches were less if females had irradiation. It is required doses c meal, and 100,000 r to cause the Viable, fertile J_1 progeny could be 5000 r, Eggs were found to vary from 800 r to 7500 r, and 75,000 r. Pogonomy may be reared Whenever larvae could be grown of producing viable eggs if physical (Also published as 18 report, N (1959) 583-90)

1-C-S GERM CELLS (I)


Studies are described to test the 6 Sperm either in males of Melanoloba and translocation determined by both loss and translocation frequency; was found for loss in fewer frequency on second day is almost, first 5 are given. The cause investigatión. (from abstr.)

Abrahamson, S., Hendt, L. FOLLOWING IRRADIATION OF FE

Alexander, M. L., Stone, W. S. VIRUS. Proc. Natl. Acad. Sci. The relationship between x-ray d. Damage was measured as increase fold between stages, depending o discussed in detail. Radiation is shown to be similar to that in situation very much as the female, T amount of damage to paper. W essay modified the internal environments of the nematode between physiological activity an
from an activated Co-source (Harwell). A brief note was presented on how this effect, coupled with the sterilization of males by the same means, could be used to a limited extent in the control of mice flies.

From 1968 - [1964]

1159


Studies were undertaken to evaluate some of the biological effects produced by γ-ray in the mosquito, Aedes aegypti. It has been checked that egg production was reduced either by exposing normal females with males which had been exposed or in females previously to doses of about 30 000 r, or by irradiating females with doses in excess of 2500 r (with no exposure at 16 000 r). Reduction in egg hatch was proportionate to doses in excess of 2500 r, applied to either adult males of females, with no eggs hatching at 16 000 r. Egg hatch was less if females had been irradiated prior to exposure than if irradiation had occurred after irradiation. It required doses of 20 000 r to inhibit egg production in females exposed 4 h after a blood meal, and 100 000 r to cause the same effect in mosquitoes which had had a blood meal 48 h previously.

Viable, fertile F1 progeny could be produced only from females which had been irradiated at doses lower than 5000 r. Eggs were found to be more sensitive to irradiation during the prehatching period, the LD50 varying from 800 r to 7500 r, and most resistant when 3 to 5 d old, the LD50 ranging from 50 000 r to 75 000 r. Progeny could be reared only from eggs which had been irradiated at doses less than 2500 r. Whenever larvae could be grown successfully to adults, the resulting adults proved to be fertile and capable of producing viable eggs if physically capable of mating. (end.)

(Also published as US-report. NM 42 01 69 05 01. Naval Medical Res. Inst. Bethesda, Maryland 16 (1966) 935-96)

1-C-3 GERM CELLS (INCLUDING OOGENESIS AND SPERMATOGENESIS)

1164

Abrahamson, S., Telfair, J. D. SEX CHROMOSOME LOSS AND TRANSLOCATION FREQUENCIES IN DROSOPHILA MELANOGASTER AFTER X-RAYING SPERM IN MALES OR IN FEMALES. (end.) Genetics 50 (1965) 985-8.

Studies are described to test the effect of homogeneity, age, and stage of germ cells on x-ray mutations. Sperm either in males or females were x-rayed and frequency of sex-chromosome loss (partial or complete) and translocations determined by Muller's genetic stocks and procedures. The experimental plan is described. Both loss and translocation frequencies were lower from sperm treated in males than in females. No difference was found for loss in first and second day insemination, while the decline shown by the translocation frequency on second day is somewhat doubtful statistically. Mean losses of male x's, for eggs laid on first 12 d are given. The extent of participation of maternal chromosomes in the translocations is being investigated. (from abstr.)

1165


1166


The relationship between x-ray dosage and genetic damage was determined throughout the meiotic cycle. Damage was measured as dominant lethals and translocations. The number of aberrations varies from 2-100 fold between stages, depending on the physiological conditions at irradiation. Susceptibility and damage are discussed in detail. Radiation damage to the different stages of oogenesis in the female Drosophila has been shown to be similar to that in Scirca and Habroscara. The comparable stages in the male respond to radiation very much as the female. The enzyme activity as modified by the gaseous environment influenced the amount of damage to pupae, even without an external source of oxygen, irradiation in carbon monoxide modified the internal environment and increased radiation damage above that in nitrogen at all stages. The sensitive stages of the maturation cycle in the male Drosophila are particularly useful in studying the relations between physiological activity and genetic damage from radiations. (from auth. summary)

Experiments were performed to test the influence of aging on the mutation frequency of sperm irradiated in females under different conditions: 1. There was no significant difference in the II-III translocation frequencies obtained when sperm were not aged and irradiated, aged and irradiated, and irradiated and aged. 2. When sperm was transferred from aged versus non-aged males was transferred in females no significant difference was found in the sex-linked recessive lethal frequencies obtained. Significantly higher mutation frequencies were observed, however, for sperm irradiated in females as compared to sperm irradiated in males. Moreover, sperm ejaculated on the second day after treatment had a translocation frequency about half as great as those ejaculated on the first day after treatment, and the frequency of this latter group was almost half that of sperm treated in females. (auth.)

Abrahamson 1957 - [1354]

Abrahamson, S., Herashizita, I. H. INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. I. OVARIOTROPIC RATE AND EGG MORTALITY IN RELATION TO INTESTIVITY AND DOGMA OF X-RAYS APPLIED TO OOCYTES. Genetics 42 (1957) 405-20.

Does up to 5500: produced no greatly observable reduction in the number of eggs laid, while higher doses did. The results prove that there is an intensity-dependent fraction of induced egg mortality which can, under certain conditions of irradiation, result in the death of at least 32.5% of all eggs oplotted during the first 5 after treatment. Parallelism was found between half-translocations and the intensity-dependent component of egg mortality in all comparisons of behaviour which were made, confirming evidence that the latter is largely due to the joint result of multiple x-ray-induced events. It is postulated that at least part of the intensity-dependent fraction of egg mortality represents a dominant lethal mutation which have their basis in two or more independently produced lesions in the maternal chromosomes. In addition to the intensity-dependent fraction of egg mortality there is an intensity-independent (relatively independent) fraction.

Abrahamson 1959 - [1355]


Mutation rates were obtained for three specific loci on the third chromosome of D. melanogaster. With a dose of 5000 r of x-ray radiation, the rate for mature sperm varied from 5.7 x 10^-5/x for the larval and adult loci. The x locus gave an average rate of 5.5 x 10^-5/x per locus. Of the 3 x-ray-induced mutations, 20 were viable, 15 were lethal, and 5 were semi-lethal, when homozygous. Spermatozoa cells in larvae crossed to 82D old were irradiated with 990 r at x-ray. Single mutant individuals and clones of the same mutation were recovered from adult males which had been treated as larvae. A variation in the size of the clusters indicated that the number of spermatozoa under test varied from 7 to more than 100. The spermatozoal mutation rate is estimated to be approximately 3.2 x 10^-6/x per locus. Four spermatozoal mutations were viable, 3 lethal and 1 semi-lethal in the homzygous condition. A lower average mutation rate obtained for spermatozoa than for sperm can be better explained by a differential genetic sensitivity of the 2 stages by germinal selection. (auth.)


Induced translocations were used to demonstrate genetic differences in different cultures of developing germ cells under various physiological conditions. Males, 20 to 25 hours after eclosion, were irradiated 2000 r in 1 min at 8-degrees C in a gas mixture with suitable pre- and post-treatment, mated individually to those marker females for 4 days thereafter each male was reared every 48 h for 9 (4-9) mating periods. The first sperms used in insemiinating females in lots A and B represent the advanced stages at irradiation; sperm used in subsequent matings were from earlier stages to spermatozoa by H and L. In most cases the percent of translocation in (8-10 d) corresponded to the values obtained for mature sperm treated under the same conditions. By D (1-13 d) or E (13-18 d) the frequency increased two or threefold. The values for all at the peak were 20 to 25% as compared to 17.9% for mature sperm from earlier experiments. In 0% N2 x 4% O2 the rate was 20% compared to 10% to 70% at 8. After the peak, the dose a few offspring from melon carbon monoxide mixture. The

1161 Alexander, M. L. DOMINANT I CELLS OF DROSOPHILA VIRILIS I. The pyramidal germ cells of D. virilis have increased in more mature cells (A & B) was 5.4. Sexed to 5.9% when the dose recovered were from mating period for the second and 50.0% for the intermediate between these two types sensitive cells of period A and B. A pre- and post-translocation. Cells E lethals calculated with the high p about 1.5 to 2 times for the most dropped to a value of 1.9% for periods D and E. Small egg size, distinguish between cell degeneration. None of the eggs checked in per period. Neither the previous per (Abstract of paper presented at the 27-29 Aug. 1959)

1162 Alexander, M. L. DOMINANT I VIRUS FROM 220 KV X-RAY 1. 337.

Young males of D. virilis (18-21) were treated with 220 KV gamma rays for treated males were reared over other virus. Samples of this requiring procedure. The percentage of pupae develop mating period. Translocation in cells. With all these types of red was produced young sperm expressed in radial, the gamma rays lethal damage and with 200 KV x efficiency of 0.72 for postembryonic. Sticks was retained in sperm gammas and 22 MV x-rays, rapidly through these mating postembryonic cells for each of the (Abstract of paper presented at the USA 26-29 Aug. 1957)

1163 Alexander, M. L. DOMINANT I DROSOPHILA VIRILIS WITH 22 M Dominant lethals produced by rad observable radiobiological action sterility result from a reduction in maturation and prevent completion of the process. Dominant lethals were recovered, with
THE X-RAY INDUCED MUTATION IN DOMINANT FEMALES. *Genetics* 41, 5

The frequency of sperm irradiated in absence of the X-ray translocation factor irradiated and irradiated in females, initiated in females on significant difference. Significantly higher mutation females as compared to sperm irradiation times had a translocation frequency on, and the frequency of this latter.

DUAL GERM CELLS OF DROSOPHILA. INTENSITY AND DOSE OF X-RAYS

The number of eggs laid, while higher doses of induced egg mortality which can, 22.9% of all eggs oviposited during the treatments and the intensity-dependent were made, compounding evidence that the females. It is postulated that at least partial non-lethal mutations which have their chromosomal. In addition to these independent (relatively independent).

DUPLICATE IN THE MATUER AND IMMATURE (46) 45-25.

Some of D melanogaster. With a dose 10-5^{-3} for the thread was given 100% and 

D. virilis. A single mutant with non-flying treated every two days to females which were obtained from a hemizygous cross of another virol strain. Samples of the germ cells treated in various pre- and post-mitotic sections were obtained by this mating procedure. The dominant lethal damage in the different types of cells was measured by the percentage of pubescent development from the oviposited females used for the different matings, periods. Translocation tests were used to distinguish the post-mortem from mitotic and meiotic lethal damage. With all three types of radiation, the highest percentage of dominant lethals in the pre-mitotic cells was produced in the young spermatids. Less damage was observed in the more mature cells. With the dose expressed in rads, the gammas rads and 22 MV rads were similar in their efficiency for producing dominant lethal damage and with 200 kV rads as the standard radiation, both given an average relative biological efficiency of 0.70 for gammas rads. The high proportion of dominant lethals induced in young spermatids was retained in spermatids from germ cells treated in mitotic stages. By both gammas rads and 22 MV rads, however, dominant lethal damage decreased more rapidly through these mating periods. The characteristics of the radiation damage in both the pre- and post-mitotic cells for each of the three types of radiation were consistent at levels of 500, 1000 and 2000 rads.


Young males of D virilis (28-29 day old) were treated with one of three types of irradiation: 200 kV x-ray, 1.50-1.33 MeV gamma rays from a cobalt-60 source, and 28 kV x-ray from a betatron source. The treated males were removed every two days to females which were obtained from a hemizygous cross of another virol strain. Samples of the germ cells treated in various pre- and post-mitotic sections were obtained through this mating procedure. The dominant lethal damage in the different types of cells was measured by the percentage of pubescent development from the oviposited females used for the different matings, periods. Translocation tests were used to distinguish the post-mortem from mitotic and meiotic lethal damage. With all three types of radiation, the highest percentage of dominant lethals in the pre-mitotic cells was produced in the young spermatids. Less damage was observed in the more mature cells. With the dose expressed in rads, the gammas rads and 22 MV rads were similar in their efficiency for producing dominant lethal damage and with 200 kV x-ray as the standard radiation, both given an average relative biological efficiency of 0.70 for gammas rads. The high proportion of dominant lethals induced in young spermatids was retained in spermatids from germ cells treated in the mitotic and post-mitotic stages both with gammas rads and 22 MV rads. With 200 kV x-rays, however, dominant lethal damage decreased more rapidly through these mating periods. The characteristics of the radiation damage in both the pre- and post-mitotic cells for each of the three types of radiation were consistent at levels of 500, 1000 and 2000 rads.


Dominant lethals produced by radiations in meiotic and spermatogonial cells results from at least two observable radiobiological actions. Some cells degenerate in the series of treatments, and periods of sterility result from a reduction in the number of mature sperm. Another type acts as a lethal after fertilization and prevents continuation of early embryonic development. With fast neutrons and gammas rads, both lethal types were recovered, although the proportion of the two may not be the same. Lethal damage

273
produced in spermatogenesis with 22 MV x-rays (rotation source) was previously obtained for doses from 435 to 2000 Rads. In meiotic and especially spermatogonial cells, even greater amounts of lethal damage were recovered with the same dose of 22 MV x-rays as with 200 MV x-rays. Sensitivity of meiotic and some spermatogonial cells in Dro sophila have been underestimated. Increases in 50% lethals have been recovered with 190 rads of 22 MV x-rays and 22 MV x-rays (170 rads). Doses of 2000 rads of both radiations produced maximum damage; 96% of the cells contain lethals. Genetic lethals account for one-half the damage, cell degeneration the other half. Estimates of the relative dose for genetic lethals in 50% of the cells were as high as two. Only about one-half the dose of 22 MV x-rays was necessary than with 200 MV x-rays. In postmeiotic, immature spermatids, 200 MV x-rays produced higher lethal values than 22 MV x-rays and RBE values from 0.64 to 6.76 were obtained.


Germ cells of D. virilis were exposed to spermatogenesis to neutrons in oxygen and nitrogen atmospheres. Dominant lethals and translocations induced in the postmeiotic stage were considerably higher in oxygen than in an N2-atmosphere. Spermatids showed a greater difference than spermatogonia. The similarity in shape of the curves for induced translocations indicates that the differences in radiosensitivity is not a function of the gaseous environment in terms of the frequency of chromosome breaks. Dominant lethals produced in the developmental stages tested occurred with various frequencies in O2 but with the same frequency in N2. The particular gas used had no effect on the number of lethals induced by radiation in spermatogenesis.


The radiation damage produced by the density ionizing radiation from fast neutrons was tested by studies of various stages of pre- and postmeiotic germ cells of Drosophila virilis. Young males were treated with doses of 600, 1200 and 2400 X 10^4 rads/cm^2 and the various types of cells sampled by successive measuring periods. The induction of translocations and dominant lethals in the various stages of spermatogenesis was tested. Translocation and dominant lethal damage produced from neutron treatment in the immature germ cells increased proportionally with an increase in dose. The damage obtained for each type of cell in the spermatogonial cycle varied in a curve which would be expected when multiple chromosome breaks are produced from a single proton hit. The radiation damage increased linearly with dose in the various types of cells although the relative sensitivity of the various stages was not the same. Postmeiotic germ cells (p-17) varied in sensitivity to chromosome breakage with the sensitivity peak occurring in the spermatocytes sampled 12-15 days after treatment (Period 3). A neutron dose of 1.5 to 2 times greater is required to produce the same amount of radiation damage in the more mature type of cells (B) as in the D type. Cells treated in meiotic and premeiotic stages contained fewer translocations and lower percentages of dominant lethals than postmeiotic cells. The reduction in the number of spermatogenesis in treated males in mating period G indicated that some types of spermatogonial germ cells degenerate as a result of neutron treatment. The relative biological efficiency of nitrogen neutrons and 200 KV x-rays differ in mature sperm, spermatids and meiotic cells. Fission neutrons are at least six times more effective than x-rays in mature sperm; in spermatids, the difference is only 2-3 times larger for neutrons. In meiotic cells fission neutrons are only 1.6 times more efficient. (auth.)

Alexander 1958 - [1958]


Studies of the radiation damage in cells undergoing spermatogenesis in Drosophila virilis showed quantitative and qualitative differences from radiation treatment. The biological damage from radiation was found to depend on a number of factors including the physical characteristics of the radiation and the interaction of the radiation with the biological system. An inverse relationship was found for the amount of lethal damage and the ion density of the radiation in meiotic and spermatogonial cells. Environmental changes

were found to enhance or suppress data are presented from a series of radiation damage with 200 KV x-rays of fast neutrons on ganet (NSA 19: 21506, 1959)

1187

Alexander, M. L., Bergendahl, GERM CELLS OF DROSOPHILA;

Data on translocation and domi 22 MV x-rays from 21 MeV b. The average RBE values for fast x-rays. The percentage of bion" man with the physical mean agreement in the difference in for calculating the LDT. The thereby describes the radiobiology The physiology of the cells and in such an evaluation.

1188

Alexander: 1958 - [1958]


Young males which had undergone irradiation frequencies analyze testes. Spermatogonia are the meiosis, the peak probably on declines again to about half its normal size when exposed to X-rays. The maximum radiation sensitivity of D. virilis for radiosensitivity is shown in Figs. 1 and 2. The results show a steady decrease in radiosensitivity of D. virilis to X-rays from 125 to 255 days exposure. The data was taken from the 1957-1958 series.

1189

Baker, J. M., Hoffman, D., & DES RADIUMS NACH DES RICARD method. Strahlentherapie 96 (1957). 1-3 b old Drosophila eggs were made and radiated with two parallel X-rays. The results show a steady decrease in radiosensitivity of D. virilis to X-rays from 125 to 255 days exposure. The data was taken from the 1957-1958 series.

1171

Robertson, J., Hoffman, D., & DES RADIUMS NACH DES RICARD method. Strahlentherapie 96 (1957). 1-3 b old Drosophila eggs were made and radiated with two parallel X-rays. The results show a steady decrease in radiosensitivity of D. virilis to X-rays from 125 to 255 days exposure. The data was taken from the 1957-1958 series.

1171

Robertson, J., Hoffman, D., & DES RADIUMS NACH DES RICARD method. Strahlentherapie 96 (1957). 1-3 b old Drosophila eggs were made and radiated with two parallel X-rays. The results show a steady decrease in radiosensitivity of D. virilis to X-rays from 125 to 255 days exposure. The data was taken from the 1957-1958 series.
were found to enhance or suppress biological damage to a greater degree with X-rays than with neutrons. Data are presented from a series of studies on dominant lethal and nonlethal damage in spermatogonial, radiation damage with 200 kV x-ray, 1.41 and 1.33 MeV gamma rays, and 22 kV X-rays; the effect of fast neutrons on gametogenesis; and the influence of environmental factors on radiation damage. (NIA 10: 819-95, 1969)


Data on translocation and dominant lethal damage are tabulated for 200 kV x-rays, gamma rays from Co-56 and 22 MeV X-rays from a 51 MeV betatron source, from 500-2000 r. The comparative effectiveness is discussed. The average RBE values for spermatogonial cells were 1.09, 0.98, 0.70 for therapy x-rays, gamma rays and betatron x-rays. The percentage of biological damage produced by the various radiations agree to a qualitative manner with the physical measurements of linear transfer or ion density per micron of the radiations. The agreement of differences in ion density and changes in biological damage depends upon the method for calculating the RBE. The biological results suggest that any one set method will not be sufficient to wholly describe the radiobiological action dependent upon the physical characteristics of the radiation. The physiology of the cells and the interactions of the cell to environmental conditions must be included in such an evaluation.

Alexander 1960 — (594)


Young males which had undergone irradiation were mated at set intervals, and the resultant "boost pattern" of mutation frequencies analyzed to give a sensitivity pattern for the different cell types from the irradiated testes. Spermatogonia are the least sensitive stage, whereas sensitivity rapidly rises to a peak during meiosis, the peak probably only being reached in spermatids. With maturation of the sperm, sensitivity declines again to about half its peak-period value.

Bauer, J., Müller, K. BEITRAG ZUR DOSIERUNG DER BETA-STRAHLEN DES RADIUMS NACH DER BIOLOGISCHEN METHODE. I. MITTEILUNG (Dosimetry of 8-rays from radium by the biological method, 1) Strahlentherapie 87, 2 (1950) 310-4. (In German)

1-3 h old Drosophila eggs were used for the measurement of 8-ray from radium in 8 units. The damage curve of a Ra preparation, prefiltered with 2 mm molybdenum, was compared with that of known hard neutron radiation. From the ratio between total radiation and 8-radiation, the 8-radiation could be determined. As a 1 cm local distance, the proportion of 8-rays was 1:9. It was confirmed that the sensitivity of D. eggs to radiation is independent of wave length as long as this is below 0.25 A. (EM 14, 7 (1958) 1759)

Bauer, J., Hofmann, D., Kapp, K., Müller, K. BEITRAG ZUR DOSIERUNG DER BETA-STRAHLEN DES RADIUMS NACH DER BIOLOGISCHEN METHODE (Dosimetry of 8-rays from radium by the biological method) Strahlentherapie 99 (1968) 249-7. (In German)

In Drosophila eggs of a medium age of 3 h, the depth of penetration was determined and the spatial dose distribution of the total radiation from a Ra preparation (filtered through 2 mm molybdenum) in an aluminum phantom. From the relation of the density of Al to the density of water, a rise of the dose up to 29% in 25 mm depth was determined for the 8-radiation. The practical range of the radiation amounts to 4.2 mm. The share of the 8-radiation can be neglected. (CA 47: 6998c, 1959)

Baker 1967 — (440)


Young eggs up to 6 h old were killed by approximately 4000 r (from a 1-c Co-60 source). 24 h-old eggs in which embryonic development was about 50% complete were much more resistant and hatch was unaffected by irradiations up to 3600 r, reduced 12% by 6000 r and 40% by 12,000 r. Complete development from irradiated egg to adult was possible with a dosage of approximately 2000 r, and the resulting adults

277
mated and produced normal progeny. Dosages in the range of 7600 to 60,000 r permitted pariperal development but this was greatly reduced at 50,000 and 90,000 r at which levels the pupation was only 0.56; 120,000 r permitted development to 3rd-instar larvae but prevented puparial formation. Third-instar larvae exposed to irradiations from 1000 to 2600 r survived and from 37 to 705 formed puparia but were unable to emerge in the adult stage. The results are promising for irradiation as a quarantine treatment for fresh fruits and vegetables infested by fruit flies and possibly other insects. Although the lethal effects are not immediately apparent up to 5000 r, the complete development of irradiated eggs and larvae to the adult stage is prevented by dosages of 7600 and 90,000 r. (From Abstr.)

1172 Bateman, A.I. MUTAGENIC SENSITIVITY OF MATURING DROSOPHILA SPERM. I. DOMINANT LETHALS. J. Genet. 54 (1958) 401-16.

The dominant lethal rate was followed in daily sperm samples from males irradiated on their first day with 1000 r and various higher doses up to 30,000 r. The control rate of non-hatching eggs, 0.93%, was taken to be the spontaneous rate of dominant lethal mutations. Irradiation of mature sperm gave an induced dominant lethal rate of 10.20%, corresponding to a doubling dose of 98 r. The change in dominant lethal rate from day to day was interpreted as a 50-fold increase in sensitivity to mutations in the immediately post-metiotic spermatids followed by a gradual decrease from 4 d prior to maturity until the day before full maturity. The last 2 d were the only period (since the pre-metiotic stages) over which no change in sensitivity was detectable. The doubling dose for the most sensitive stage is 3 r. Whilst mature sperm have remained viable at the highest dose used (20,000 r), immature sperm were killed by 10,000 r. The sensitivity of spermatogonia to chromosone breakage is probably of the same order as for mature sperm. Mitotic stages are probably killed by a dose of the same order as produces 100% dominant lethals in immature sperms. (From auth. summary)


It is known that the early post-metiotic stages of Drosophila sperm are more sensitive to the mutagenic effects of X-rays. To study this phenomenon in more detail and in a more quantitative way the author chose the dominant lethal response as the simplest genetic change available for study. The incidence of deleted X’s is measured as hyperploid females in the progeny of irradiated wild-type males mated to attached-X females. A re-estimation is made of the dose dependence of this rearrangement, using several doses from 1000 to 10,000 r on mature sperm (utilized within 3 d of irradiation). The fit of the regression line is good over the whole range studied. In samples of sperm from 1 to 10 d after irradiation of the male with 1000 r, the variation in frequency of hyperploids is, by and large, consistent with the data for the variation in dominant lethals and the dose dependence of hyperploids. This would lead one to expect that a 10-fold increase in sensitivity to dominant lethals would be accompanied by a 50- to 50-fold increase in yield of hyperploids. It is concluded that both phenomena are due to the increased breakability of the chromosomes of spermatids. There are indications that spermatids may have opportunities for rearrangements which no longer exist at later stages.

1174 Bateman, A.I. MUTATIONS IN IRRADIATED SPERMATOCYTES. Drosophila Inform. Serv. 32 (1966) 133.

From the Drosophila data obtained the author concludes that, if a broad classification of germ cells according to their responses to mutagens is to be made, it should be done in spermatogonial and post-spermatogonial rather than into pre- and post-metiotic.


Wild-type Drosophila males were treated with 1000 r and 4000 r of X-rays and the frequency of recessive lethals recorded for genes which, in the time of irradiation, were at the stages of mature sperm, spermatids and spermatogonia. The shape of the integral frequency-dosage curve for lethals was found to be wholly determined by the mode of dependence upon dosage of the frequency of lethals in mature sperm. The lagging of the lethal frequency in spermatids behind that expected on the basis of a direct proportionality rule is practically not at all reflected in the shape of the integral curve. This is evidently to be explained by the fact that the absolute number of lethals originating in spermatids is very small, as compared with that of lethals originating in mature sperm, because at any given moment the latter are much more numerous than the former.


* Bender 1958 - (1957)

1177 Bonnet, R. C. von. RÜCKLICHT UNDIST X-RAYS ON THE FEMALE HAHNENCHEN. They were untreated. The developmental described and possible mechanism of this effect are described and possible mechanism of this effect are described. * Bonnet and Rogers 1958 - (1957)

1178 Brachet and Scholer 1958 - (1957)

1179 Brachet, H. ZUR ENTWICKLUNG (Concerning the development of Drosophila) (1951) 479. (In German)

The Drosophila oocyte is the germ cell stage which is formed into a fully formed female by the female follicles before it is laid. The oocyte follicles are formed in the female, but in the female they are formed in the male, before the ovaries are formed in the female. It is concluded that the development of the oocyte is not determined by the development of oocytes or the development of oocytes in the oocytes of the oocytes.
more numerous than the former. This study shows that the positive heterogeneity of the stage of development of the testis germ cells, does not show in many previous investigations of the dependence of mutation frequency upon the dose of radiation. does not invalidate the conclusions drawn from such investigations, provided these conclusions refer to mature sperm only.


A series of special experiments was carried out in order to discover the dependence on dose (for 1000-6000 r) of lethals arising in Drosophila melanogaster (Algerian and Rhodes) mature sperm, spermatids and during spermatogenesis. The tabulated data show that the frequency of lethals in spermatids induced by 6000 r increased by a factor of 1.4. In mature sperm, however, the increased dosage induces a linear increase in the frequency of lethals. (NSA 13: 9587, 1959)

* Bender 1958 - [1970]

* Berset, R. C. von. FEULGEN-NEGATIVE NUCLEAR DIVISION IN HARBOURACON EGGS AFTER LETHAL EXPOSURE TO X-RAYS OR NITROGEN MUSTARD. Nature 175 (1955) 842-3.

Female Harbouracan were treated with a lethal dose of x-radiation or an equivalent dose of nitrogen mustard. The developmental pattern of eggs which were in metaphase I during the time of treatment is described and possible mechanisms of action of the mutagen discussed. (NSA 9: 3504, 1955)

* Berset and Rogers 1955 - [1960]

* Brandt and Höhne 1955 - [1972]


The Drosophila ovary is composed of 8 different elements having different origin and time relations. These elements are the germ cells and the mesodermal somatic cells. In the present experiments the germ cells were x-rayed early, in female larvae ready for pappation, and in 6-h pupae (5500-5000 r). Nowhere were follicles formed before treatment, and the complete extinction of ovaries could be accomplished with practically no damage to somatic tissues. In files which had been x-rayed at 24- to 48-hour-old pupae no undivided oocytes could be found. Instead of ripe egg cells in many small, undeveloped egg cells were present in each follicle. It is concluded that the influence of the germ cells on the somatic ovarian tissue begins very late in development, always more than 8 h after pappation. If follicle formation is stimulated, this is independent of the development of the enclosed germ cells. In the genesis of the ovary both developmental and autonomous phenomena of development occur.


(CEN-15) (In Italian)

According to a general rule, the behaviour of identical genotypes is identical, short of maternal effects, in a diploid zygote, irrespective of whether they are carried via the sperm or the egg. In order to ascertain whether mutation rates of the same genes are different when derived from the male, as contrasted to the female, batches of 1-th-vold eggs of D. melanogaster obtained from the cross yrR YS X YR and its reciprocal yrR yrS X yS yS were x-rayed with doses of 240 and 420 r. While no significant differences were found in the frequencies of somatic mutants, as revealed by mosaic, unexpected differences were found in the egg mortality and in the sex ratio of the surviving adults. The data are tabulated. (from zufi.)

* Chaudhary and Bannister 1960 - [1957]
1185 Fritz-Niggli, H. BIOLOGIE UND WIRKUNGS MECHANISM Von RÖNTGENSTRAHLEN U. DAMAGE TO Drosophila EMBRYONEN. Naturwiss. 32 (1945) 245-64. (In German)

Dose-effect curves which show, of D. melanogaster eggs exposed stages show very high mitotic activity varies markedly with the sensitivity occurring at 18 h. * In 15 h, old eggs damage is c. 11% of the adults eggs a certain. A hit-theory explanation of the

1186 Fritz-Niggli, H. VERGLEICHE 180 keV UND 31 keV (COMP. TO 31 MeV). * Funicula, Romp

In view of the variation of rad. effects of x-rays (180 keV) and are set down in detail, and the 11 and 14 h. Prior to differenti. occurrence, etc., depends on 18 h old eggs had similar effect effects of 180 keV radiation we made it impossible to secure a...
1186 Fritz-Niggl, H. BIOLOGISCHE ANALYSE DER STRAHLEN SCHÄDIGUNG VON PSEUDOPHILA-ÆRBN DURCH 180 kV RÖNTGENSTRAHLEN UND ULTRAHART 31 MeV-STRAHLEN (Biological analysis of the radiation damage to Pseudopila eggs during 180 kV x-radiation and ultrahard 31 MeV radiation). Naturwissenschaften 50 (1962) 485-6. (In German)

Dose-effect curves which show, in per cent of hatching, the dependence of radiation sensitivity on the age of D. melanogaster eggs exposed to 180 kV or 31 MeV x-rays are presented and discussed. Early embryonic stages show very high mitotic activity, maximum duration of a mitotic cycle only being 10 minutes. Sensitivity varies markedly with the age of the egg. The results are illustrated graphically, with maximum sensitivity occurring at 14 h. The mechanism of action varies with the stage of development and dose given. In 1-2 h-old eggs damage is caused by some ionization which only becomes evident later. In order to kill 51-65 % of old eggs a certain threshold of irradiation must be exceeded before damage becomes noticeable. A hit-theory explanation of the results is shown to be inadmissible.

1187 Fritz-Niggl, H. VERGLEICHENDE ANALYSE DER STRAHLEN SCHÄDIGUNG VON PSEUDOPHILA-ÆRBN MIT 180 kV UND 31 MeV (Comparative analysis of irradiation damage to Pseudopila eggs caused by 180 kV and 31 MeV). Fortschr. Röntgenstr. 83 (1955) 179-200. (In German)

In view of the variation of radiosensitivity with egg age, only an age spread of 4-6 h was admitted. The effects of x-rays (180 kV) and B-rays (31 MeV) were compared on 118 014 eggs. Methods and calculations are set out in detail, and the results tabulated and discussed. Maximum sensitivity was observed at 14 h (0 h) before differentiation cells are particularly sensitive. The kind of radiation effect (moment of occurrence, etc.) depends on dose and age. An equal dose of 31 MeV and 180 kV radiation on 1 and 14 h old eggs had similar effects both qualitatively and quantitatively. On 4, 4.5 and 7 h-old eggs the lethal effects of 180 kV radiation were greater. With 3 h eggs, results seem to be similar but the wide spread has made it impossible to secure a mathematical comparison.

1187 Fritz-Niggl 1957 - [824]

* Fritz-Niggl 1958 - [825], [826], [829]

1188 Glau, B. DIE VERSCHIEDENEN BEREITSLAUFUNG DER MUTATIVITÄT REIHER UND UNBEFERT KEM- ZÜLLEN DURCH BEREITSLAUFIGE IN N2 + O2 + CO-ATMOSPHÄRE (The varying influence on the mutability of mature and immature germ cells by irradiation in N2, O2, and CO atmosphere). Strahlentherapie 109 (1963) 402-11. (In German)

The rate of mutations of dominant and recessive lethal factors and translocations in Pseudopila depends on the stage of development of the germ cells irradiated in air. The scale of mutability is the same for all types of mutations, beginning at the most sensitive stage: spermatogonia, spermatids, mature sperms, spermatocytes. Irradiation in pure N2 and CO atmosphere decreases the rate of mutation. The protection effect of CO is less than of N2. The protection effect depends on the stage of development of the irradiated germ cell. Mature sperms respond little to protection factors. Their rate of mutations is increased by irradiation in pure N2 atmosphere. The rate of mutation of irradiated spermatids and spermatocytes can be decreased considerably by irradiation in pure N2. Spermatogonia are indifferent to irradiation in N2 atmosphere. The possibility exists that an increased proportion of O2 of spermatids and spermatocytes, as compared to mature sperms, may explain their sensitivity to mutagens. (auth.)

* Glau Medeis 1961 - [829]


Spermatogonia and oocytes irradiated simultaneously with x-rays yielded only 1 translocation in 2599 oocytes compared to 161 in 2651 spermatozoa. The frequency of translocations from treated spermatogonia within 8 to 11 d after treatment was almost twice as great as the frequency in spermatogonia used same time after treatment. All translocations induced in oocytes occurred in the first brood (1-3 d after treatment). Inversions, detected genetically, are induced by x-rays about 3 to 4 times as frequently in spermatogonia as in oocytes. The ratio inverted/inserted is 40 to 50 times as great as the corresponding ratio for translocations. This is interpreted to mean that the frequency of chromosomal breakage in oocytes differs little from that in

201
spermatozoa, and that the differences in the frequency of rearrangements result from a difference in the probability of recombination related to the proximity of the breaks.


Dominant Minute-bristle mutations attributable to chromosome deficiencies were produced at x-ray doses from 1000 r to 4000 r with equal frequencies in oocytes and spermatozoa. The dosage curve is rectilinear up to 2080 r, and above that the curve increases approximately at the 1:5 power of the dose, hence at low doses most Minute results from single "hits" but at higher doses there is an increase in 2-hit effects. The study confirms that chromosomes are broken by x-rays with equal frequency in spermatozoa and mature oocytes. The failure of genes chromosomal rearrangements to occur in the latter must be attributed to a diminution, more rapid in the oocytes than in spermatozoa, of the probability of recombination between breaks as distance between them increases.


The author reviews many aspects of the subject. Great differences have been found to exist in the induced mutation rates in mature germ cells as compared with immature ones. The effect of sex on x-ray induced mutation rates, and of the period of gametogenesis on the induced mutation rates in males and in females are examined in some detail. If the genetic effects of high energy radiations are to be assured successfully, the difference in mutability exhibited by various stages of gametogenesis or by the male and female germ lines must be established, particularly in those phases of the germ line in which the germ cells persist for the longest periods.

* Glazebrook, Et al, 1960 - [995]

* Gieseck 1960 - [1139]

* Gind and Paul 1950 - [1331]

* Heidenhthal and Clark 1951 - [1154]

* Heidenhthal 1952 - [956]

* Heidenhthal et al, 1954 - [952]

* Heidenhthal et al, 1956 - [959]


This paper is concerned with the problem of difference in dose rate. Are genetic effects the same, or different, when dose rates are widely different but total dose accumulated is the same? A conventional 80 kv x-ray machine was used for the low dose rate work. The electron beam generator which yielded a rate as high as 5000 r/min was the source of high dose rates. The materials irradiated were Habrobraccus oocytes in first meiotic prophase and metaphase stages. These were studied for hatchability or presence of dominant and recessive lethals. F_2 virgin females were reared from prophase oocytes treated with 10,000 r. They were tested for heterozygosity with respect to recessive lethals. The data so accumulated indicate that with these materials, when total dose of x-rays and cathode rays are the same, the wide difference in dose rate has no significant effect. (null.)


Oocytes, containing an attached-X but no Y chromosome, were x-rayed with 1600 and 4000 r to obtain the detachments of the arms of the attached-X, which in Tagorour's report are called "healed" breakages. The data indicate a less random distribution of the breakage points among the autosomes, partially in translocations in the case of oocytes than is known for spermatozoa. These observations make untenable the view that new telomers are formed.


A concentrated treatment of oc lethal in Drosophila that did this dose delivers of the lethals produce many as half the lethals produce.

Henikowitz, L.I. STUDIES ON BY X-RAYS. DROSOPHILA INFERN.

Two types of adult female Drosophila over a 20 min period. Bones red/flying than by red/rod female higher mutation rate of the rod a considerable proportion of red broken and produced by x-rays that the intensity-dependent leth changes could include small del crossing over - intra-teratol eX

Henikowitz, L.I. A RELATION SHIP FOR EPID X-RATED IN

II-IU translocation frequencies x treatment of fragmented female periods after treatment the rates 14, 156 (2000/1489), 16.6% (201/1210) resulting in only one tran translocation rate also increased tion was delivered in different x 1900 r/min, as described in the (Abstract of paper presented at 1 26-28 Aug. 1907)

Henikowitz, L.I. HETEROGENEITY OF X-RAYS.

Approximately 2800 r were died (in 1 min, 45 s) or (8) demonstrates that one location rates for all X males to and 18.7% for R (335/1823). But 4 successive 4th periods followed between results for A and R under those experimental conditions (Abstract of paper presented at 1 26-28 Aug. 1907).
RESULTS FROM A DIFFERENCE IN THE

THE OOCYTES AND SPERMATOGENIA

DESCRIPTIONS WERE PRODUCED AT X-RAY DOSES

The dosage curve is rectilinear at 1.5 power of the dose; hence at low

QUANTALITY IN SPERMATOCSE AND MATURE

In the latter must be attributed to a

SUBSTANCES OF GONADAL DEPRESSION IN FEMALES OF D. MELANOGASTER.

Two types of adult females Drosophila (rod/rod and rod/normal) were irradiated with 3000 r or over a 2 hr period. Intense or prolonged irradiation was given. About 90% more eggs were laid by rod/normal than by rod/rod females following intense treatment but this cannot account for the significant lower fertilization rate of the rod X in the rod/normal females. The intensity effect on lethality demonstrates that a considerable proportion of such mutations induced in oocytes are multi-hit events. Since it is known that broken ends produced by x-rays to oocyte chromosomes can join soon after their production, it is suggested that the intensity-dependent lethals are connected to their origin with multi-break exchanges. Such exchanges could include small deficiencies and duplications acting as recessive lethals produced by "pseudo crossing over" - intra-chromosomal exchange between nearby nonhomologous loci.

A RELATIONSHIP BETWEEN TRANSLATION FREQUENCY AND AGE AT FERTILIZATION OF D. MELANOGASTER.

B-I1 translocation frequencies were determined in F1 males from successive groups of eggs laid following treatment of inseminated females with approximately 3000 r. For the first 4 consecutive 4- to 6-day posttreatment periods after treatment the rates, combined for different experiments, were, respectively, 12.3% (111/900), 14.3% (209/1690), 16.5% (201/1194), and 19.3% (153/804). (The same dose given to females before mating resulted in only one translocation in 3164 tests, hence the above translocations were paternal.) The translocation rate also increased in successive hours in each experiment even though the irradiation was divided into different ways, continuously either at 1000 r/min or 3000 r/min or discontinuously at 1000 r/min, as described in the preceding abstract.

(Abridgment of paper presented at the 1957 meeting of the Genetics Society of America, Stanford, California, 26-29 Aug. 1957)

INTENSITY-INDEPENDENCE OF TRANSLOCATIONS FROM SPERM X-RAYED IN FEMALES OF D. MELANOGASTER.

Approximately 3000 r were delivered to inseminated females at about 1000 r/min either (A) continuously for 1 min (30 r) or (B) incrementally for 1 min (15 r) in seven 18-irradiations given a min apart. The continuous treatment was also given to virgins subsequently mated with unirradiated males. The B-II1 translocation rate for all F1 males tested was 5% for C (no translocations in 422 tests), 14.5% for A (123/844), and 19.3% for B (253/932). Included here are counts for A and B of all F1 males from eggs laid in the first 4 successive 4- to 6-day periods following irradiation. When individual 4-day periods were compared, the differences between results for A and B remained without significance (note following abstract). It is concluded that under these experimental conditions the irradiation has a significant effect on translocation rate.

(Abridgment of paper presented at the 1957 meeting of the Genetics Society of America, Stanford, California, 26-29 Aug. 1957)

INDUCED CHANGES IN FEMALE GRAM CELLS OF DROSOPHILA.

Half-translocations (of the type in which an attached X chromosome is broken into two arms, only one of which is retained in the egg after joining eccentrically to a piece of another broken chromosome, the other, reciprocal, piece becoming lost) were employed as a measure of multi-break chromosomal rearrangements induced by x-rays administered at various concentrations to D. melanogaster oocytes. Higher concentrations
produced more half-translocations than lower ones, proving that breaks in oocytes can join in new arrangements before fertilization, not as breaks in fully mature spermatozoa (those in inseminated females). The results show that, of the junctions which will take place, the great majority do so within 6 h, and that about 1/2 do so within 4 h. Under certain experimental conditions at least 1/3 the breaks that join can do so within 1/4 h, but under other conditions junctions in this period were not detected. The relation of the results to earlier work on the dosage-frequency relationship for half-translocations is discussed and the influence of a modified X chromosome on their increased frequency is confirmed. It was found again that, among oocytes oviposited during the first 4 following treatment, there were significantly more mutations in the eggs laid in the first days than in those oviposited later. There was also a significant decrease in fecundity of the parent females in this 4- to 7 period when the treatments were more concentrated. (from auth.)


Experiments are described which determined the frequencies with which about 2000 X rays delivered in an intense manner to oocytes produced real and apparent nondisjunctions of the X chromosome or eccentric half-translocations resulting in mature egg hyperploid for all or almost all of X. The product of the latter event, invisible in the egg stage after fertilization by normal sperm, was made visible, by crossing treated females to males which produce sperm some of which are hypomodal for X, and also recognizable, by both parents having their chromosomes suitably marked with genetic factors. The genetic basis for at least 1/6 of the 40% egg mortality induced by 2000 X rays, including 1/6 of the established intensity-dependent component, is accounted for, following analysis of the data obtained. (from summary)

*K Henikowits 1957 - [1149]*


The frequency of X-ray induced crossovers depend on the way in which the treatment is given; it reaches a maximum when the full dose is applied at one time, and reduced with a fractionalized dose.


The kinds and frequencies of X-ray induced genetic recombination in female gametes of Drosophila depend upon their stage in development. In most mature cells many breaks are produced. Some resolving occurs soon after certain treatments, but is delayed after higher doses are delivered more quickly. The effects of irradiating progressively immature germ cells are described.


Dehydration of Drosophila melanogaster females significantly increases the rate of crossover-like exchanges induced by X-rays in the proximal region of the X chromosome (between cinnabar and the comodore). This dehydration effect was found in eggs laid both at the beginning and end of the first 8 days after irradiation, that is, periods when the eggs at the time of irradiation were past, and before or during, the stage of spontaneous crossing over, respectively. The frequency of gross chromosomal rearrangements, as detected by detecting attached-X's, induced by X-rays is also increased by prior maternal dehydration. These results permit the hypothesis that the increase in egg mortality, observed earlier when dehydration preceded x-ray, has a genetic basis, and that on this view it is to be considered as resulting from dominant lethal mutations. Although no cytological study was made, it is suggested that the dehydration effect may have been produced by shrinking nuclei, resulting in an increased chance for broken ends to interchange rather than reassociate. (auth.)

*K Henikowits and Baumiller 1959 - [1001]*

284

1203 Ires, P. T. RELATIONSHIP OF DROSOPHILA MELANOGASTER. Ovar. breed dosage range, the 1 (Co 60 radiation was used) is as seen visible mutagenesis, chiefly a relation to data from the sex-ata of the dose between 0.5 a h and two-hit mutations at the The two phase exponential inter- observed for X lethals and is an arrangement in lethal X chromosomes.

*K Kaufman and Wawersik 1957 - [949]*

*K Ires 1964 - [1020]*

*K King 1956 - [1013]*

*K King and Wood 1955 - [1012]*

*K King et al. 1956 - [1014]*

*K King 1957 - [1017]*

*K King 1958 - [1015]*

*K Kuhlman 1955 - [1249]*

*K Konig and Nakasima 1958 - [812]*

1204 Kosinti, S. MEIOGENIC ABNORMAL (DROSODA XAPCEONED) GERM IN ENGLISH.

Hynula of a grasshopper (Podura) kind of meiotic chromomuller (cells. They were as follows: 1, meiotic nuclear of chromosome of chromosomes. The type low temperature, and by 1955 - [1282]*

*Lamarque 1955 - [1083]*

*Lamarque and Gary-Baho 1956 - [1085]*

*Lagendorf and Sommer 1950 - [1086]*
in oocytes can join in new arrange-
ments (those in inseminated females). The
majority do so within 8 h, and that about
1/8 of the breaks that join can do so
without detection. The relation of the re-
arrangements is discussed and the in-
congruity is confirmed. It was found again that
there were significantly more mutations
in the second half of the genome.

GERM CELLS OF DROSOPHILA. V. THE
EFFECT OF X-IRRADIATION ON THE
DOMINANT LETHALITY

Experiments on Drosophila melanogaster.
Genetics 42 (1958) 101-111.

The effects of X-irradiation on the production
of mutations in Drosophila melanogaster were
studied. The experiments showed that
irradiation can lead to the formation of
mutations, including those that are
recessive and dominant. The frequency of
mutations increased with increasing doses of
radiation. The results were compared with
previous studies and showed good agreement
between the different experiments.

GERM CELLS OF DROSOPHILA.
CYTOKINESIS AND OOGONIA UPON X-
IRRADIATION

The effect of X-irradiation on the production
of oocytes and oogonia was studied. The
results showed that X-irradiation can lead to
the formation of mutations in the oocytes and
oogonia, including those that are recessive
and dominant. The frequency of mutations
increased with increasing doses of radiation.
The results were compared with previous
studies and showed good agreement between
the different experiments.

KOLWAI, S. MEIOCYCIC ABNORMALITIES INDUCED BY THE EXPOSURE TO RADON IN GRASSHOPPER (PODisma capreorum) STEMATOGENEY. Jap. J. Genet. 30, 5 (1957) 163-7. (In Japanese, summary in English)

Nymphs of a grasshopper (Podisma capreorum) were exposed to 8a in two groups for 1 and 3 h. Various
kinds of meiotic abnormalities were found to occur in the first and second meiotic divisions of male germ-
cells. They were as follows:acentric and bicentric chromosomes, formation of chromosome bridges,
varied numbers of chromosomes, and various arrangements of chromosome fragments in the metaphase plate.

The types of abnormality closely resembled those caused by a treatment with higher or lower temperature,
and by exposure to ultraviolet rays.

LAMARQUE, F. 1951 - [1286]

LAMARQUE, E. 1935 - [1286]

LAMARQUE and GARY-NABON, 1936 - [1338]

LANGERDORF and BOCHNER, 1956 - [1256]
1308 Lilling, K. G. STUDIES ON D. MELANOGASTER. Hereditas 90 (1979) 41-54.
A comparison of the mutagenic types of mutation, fractions w is induced, rare in oocytes. A -
induced in oocytes, a type rare rates, i.e. white, did not show spectrum within a very small c-
1210 Lilling, K. G., Jasmon, S. EF IN DROSOPHILA MELANOGASTER.
171 5-in seed old males were irradiated
eq 44 and 96 h after in
found about the same rates of e
is, the same for x-rays and fast neutro-
* Lilling and Jasmon 1967 - [1205]
* Lilling 1959 - [1205]
* Lilling and Hendrickson 1959
* Montig and Offedal 1958 -
* Muller et al. 1954 - [1209]
1211 Muller, H. J., Valencia, R. M.
LOCI IN DROSOPHILA BY BREA-
To study mutagenesis in larvae
sex-determined irradiated later oocytes,
 נוסנה עלencias oocytes or, more ran-
none of the mutations a
* Muller and Valencia 1951 -
1212 Murata, K., Bori, T., Motowa
CELL OF DROSOPHILA MELAN
Tokyo & Kyoto, Sep. 1956c.
Some adult males which had b
males for both sets of experim-
cont roll dropped thereafter. With
7.1% on the 8th day, and 2.1%*
* Murphy 1954 - [1402]
* Nakauchi 1956 - [971]
A comparison of the mutagenic effects of x-rays on mature sperm and oocytes shows a difference for two types of mutation, freckles and variegated-yellow mutations. In sperm a rather high rate of freckles is induced, rare in oocytes. A considerable frequency of variegated-yellow mutations are, on the other hand, induced in oocytes, a type rarely induced in sperm. A locus known "frequently" to mutate to variegated-states, i.e., white, did not show such a predominance in irradiated oocytes. This shows that the mutation spectrum within a very small chromosomal region may differ appreciably between the sexes.

In the silkworm, the eggs are laid at the stage of anaphase of the first mitotic division. When the second mitotic division begins 60 min after opposition, and finishes in 20 min. The fusion of male and female pronuclei requires about 40 min thereafter. Therefore, the time between egg-laying and fertilization of prometaphase is about 2 h at 25°C. The mutation rates and the rates of lethality induced by X-rays were examined in this time interval. As in the mustard, egg color mutants are used. In the silkworm, red and green eggs are located on the chromosome V at 0.0 and 0.1. Both of them control the color of the egg (and also of the eye) which is a character of the B generation. Whereas the normal color is black, red eggs are white and green eggs are red. Eggs homozygous for both red and green are also white. Eggs collected from the mating of *M*/*M* females with *p*/*p* males were divided into three groups: 0-40 min, 40-60 min and 60-120 min after opposition. Each of them was irradiated with the doses of 7.5, 10.0 and 15.0 krad of X-rays (an X-ray apparatus was operated at 80 KV potential and 4 mA and the dose rate was 192 rad/min). The mutation rates were calculated as the percentages of the eggs of defective types (white or red eggs, including mosaic eggs) for white or red in the total pigmented eggs. The lethality was also examined; the susceptibility of the eggs gradually increased with progress of the stage.


1214


*Nicholson 1959 - [156]*

1215


1216


1217

Oster, L.R. MODIFICATION OF X-RAY MUTAGENESIS IN DROSOPHILA. I. REUNION OF CHROMOSOMES IRRADIATED DURING SPONDAMPLOGENESIS. *Genetics* 36 (1955) 69-83.

The end of chromosomes broken during spermatogenesis undergo reunion before fertilization while the breaks produced in mature spermatozoa remain open and resume during fertilization. In these stages of germ cell development prior irradiation does not lead to an alteration in their reactions to subsequent doses of X-rays. (abst.)

1218


In order to obtain further information about the conditions affecting the sensitivity of germ cells to the induction of mutations by X-rays the irradiation of males and females was undertaken which involved the study of the effects of varying physiological factors on the irradiation of males and females. Studies were made of the effects of varying the age at which irradiation was performed, the dose delivered to spermatocytes and spermatids, the formation of the development of germ cells and the activity of other chromosomes having the same dosage levels. (abst.)

*Oster 1956 - [1604]

*Oster et al. 1956 - [1604]*

1219


Various external and internal conditions affecting the sensitivity of germ cells to the induction of mutations by X-rays was investigated. The similar effect of various mutagenic effects on the same chromosome were obtained, although the effect of the sensitivity of the other chromosomes having the same dosage levels. (abst.)

*Oster et al. 1956 - [1604]*
STAGES IMMEDIATELY AFTER MEIOGENE DIVISION. The second meiotic division is followed by the fusion of male and female gametes. Eggs, having fertilization of prophase induced by x-rays, were examined 14 days after ova were used. In the silkworm, P. polyxena, the colour of the egg (and hence its normal color is black, yellow eggs are white). Eggs collected from three groups of 0-40 min., 40-60 min. and 60-90 min. the doses of 705 r and 1560 r of x-rays, respectively (time rate was 192 r/min). The mutation rates of red or black eggs, including mosaic eggs, were examined, susceptibility of the eggs to x-rays being determined by the dose of x-rays used.


A series of experiments showed that x-rays induce the most radiosensitive stage of spermatogenesis in Drosophila. This did not appear to be due merely to a separation of broken chromosomes favoring the rearrangement of processes during spermatogenesis.

Oster 1958A - [208]


Since it is now well established that even the post-meiotic stages of spermatogenesis in Drosophila differ tremendously in their radiosensitivity and since knowledge of the relationship of lethal mutations frequency to dose employed has a bearing on the interpretation of mutational mechanisms it was decided to investigate this problem with the lens graphic techniques available. Homogeneous samples of the most radiosensitive and the most radioresistant stages of spermatogenesis, represented by spermatids and oogonia, respectively, were treated. X-rayed spermatids yielded 106/168 r (i.e., lethals among tested chromosomes) for 250 r and 180/1358 for 1000 r, while the controls gave 19/2036. This gives induced ratios of 1.38 ± 0.24% and 6.29 ± 0.30%, indicating a linear relationship. The translocation frequencies observed were 1.24 ± 0.05% (28/2314) and 1.36 ± 0.05% (23/1652), thereby showing a rise for these multi-break events proportional to (dose)^3/2. Irradiation of oogonia in third instar larvae yielded 1.7/18 006 for 600 r and 30/20568 for 2400 r, while the controls gave 49/1163. This gives induced ratios of 0.31 ± 0.06% and 1.18 ± 0.06%, again a linear relationship. For equal doses, spermatid frequencies were twice oogonial frequencies. Special methods ruled out the possibility of preceding lethals as well as the inclusion of large clusters of mutations arising from one mutated cell by mitotic division. Thus at the doses studied the strictly linear relation of lethal frequency to dose employed was upheld for the most radiosensitive germ cell stages and extended to the less sensitive ones known in Drosophila. (From above.)


The condensed state of the chromosomes of many organisms is the most sensitive to x-rays. A comparison of the radiosensitivity of Drosophila melanogaster spermatids and spermatocytes, both having condensed chromosomes, indicated that some other factor(s) is responsible, in part at least, for the greater sensitivity of the former cells. X-irradiation of mature sperm and spermatids in either nitrogen, air or oxygen which indicated a relatively greater effect of reducing the oxygen tension and a relatively lesser effect of increasing the oxygen tension from that present in air on the radiosensitivity of spermatids as compared to spermatocytes lends support to the suggestion that the high sensitivity of spermatids may at least in part due to more intra- and/or inter-cellular oxygen being normally present (or available) in these cells. It would be of interest to determine whether such a mechanism can account for the variations noted in the radiosensitivity of other chromosomes having otherwise similar morphological properties. (Sibb.) (ASA 14: 47, 1960)

Oster 1960A - [1404]

Oster et al., 1959 - [1049]


Various external and internal conditions are known to affect the sensitivity of chromosomes to irradiation and nonirradiating radiations. Although there is no a priori reason to believe that one or even similar mechanisms underlie the sensitivity of all cell stages and organisms to radiation, it seems reasonable to suppose that...
elucidation of the variation in the sensitivity of different cell stages of one cell type under a variety of conditions may help to shed light on the basis for the different differences in radiosensitivity among different organisms. It was found that the fruit fly, *Drosophila melanogaster*, is most suited for such a determination of sensitivity, since not only can induced heritable variations be easily detected and analyzed, but techniques are available which ensure that one is testing and testing cells that represent homogenous samples of distinct stages of mitotic or meiotic. The procedure is outlined which was used in the treatment of the male germ cells of the fruit fly. The results show that although the spermatids received less than one-half as much radiation as the spermatogonia in the female, they yielded one-half again as many translocations. Results of the x-irradiation on cell stages in the male and female *Drosophila melanogaster* are tabulated. (AA 14: 24011, 1960)

1233 Oh, A.H. DIE STRahlENINDUzierte MUTATIONSRATE FÜR RECESSIV OCHLIECHTIGENBUNDEN LEtalFAKTOREN IN SPERMATOCYClEN UND ERFEN SPERMEN VON DROSOPHILA MELANOGaster NACH BESTRAhlUNG IN LAUF UND STUCKSTOFF (The radiation-induced mutation rate for recessive sex-bound lethal factors in spermatogonia and mature sperm of *Drosophila melanogaster* after irradiation in air and nitrogen). *Stuttgart-Berlin* 111 (1969) 67-68. (in German)

The mutation rate (NR) for recessive sex bound lethal and semilethal factors was determined on sperms of *Drosophila melanogaster* which fertilized 0 to 24 h b and spermatogonia which fertilized 21 to 93 d after irradiation by 1960 in air. On irradiated mature sperms a NR of 3.62% for lethal and 0.73% for semilethal factors was found. After irradiation of spermatogonia 0.41% lethal and 0.9% semilethal factors were observed. Therefore about 8 times more recessive lethal factors were observed on the mature sperms than on the spermatogonia. The same types of germ cells were irradiated in pure nitrogen with the same dose and the NR determined for lethal and semilethal factors. On spermatogonia the NR was 0.40% lethal and 0.20% semilethal factors. The presence of pure nitrogen during the irradiation therefore has no protective effect on the formation of recessive sex bound lethal factors in spermatogonia. There seems to be a slight protective effect in mature sperms which is, however, not well enough founded by statistical data. (auth.)


Attached-X female *Drosophila* oocytes of various ages were irradiated, and the frequency of detachment determined in females of various ages. There is an increase in radiation sensitivity of oocytes with aging up to 3 d, after which there is no evident increase. A two-limb formation of detachment is found both in young and old oocytes. Dose fractionation experiments show that breaks in stage 7 rejoin in about 10 min, while those in stage 14 do not rejoin until fertilization. There is evidently a change in the proportions of the various kinds of exchanges when females are aged before treatment. Speculations are made as to the possible role of cytochrome oxidase activity in the changing sensitivity of oocytes. (auth.)


Dominant lethals induced in stage 7 were found to follow a "U"-shaped curve, while those in stage 14 were "L"-shaped. Evidence of partialization of breaks and rejoining of chromosomes in the origin of dominant lethals is given by the finding that fractionation of the irradiation dose while centrifuging after irradiation increases the incidence of dominant lethals in stage 7. Evidence shows that under certain conditions following irradiation is given by the induction of compound X's by irradiation of heterozygous stocks. This shows that anaphase II bridge formation might account for some dominant lethality. (An abstract of earlier work on "The origin of dominant lethals in irradiated oocytes of *Drosophila*" appeared in *Genetics* 40 (1960) 698.)

1226 Parker, D.R. THE INDUCTION OF RECESSIVE LETHALS IN DROSOPHILA OOCYTES. *Genetics* 45 (1960) 130-5.

Recessive lethal induction by x-irradiation of stages 7 and 14 of primary oocytes of *Drosophila melanogaster* was studied. Stage 14 gave about a twofold increase in lethals over stage 7. There is evidence for the occurrence of some two-hit lethals. Speculation is made on possible relation between sensitivity changes, breakage and rejoining, and recessive lethals. (auth.) (AA 14: 15606, 1960)

* Passonneau 1964 - [1221]
* Ray 1957 - [576]
* Ray 1966 - [978]

Male *Ceratitis capitata* w
cytes of 1.15 to 2.5 cm in length are for more frag
genome length is 2.5 times greater,
the 10-
* Rogers and Brown 1987 -
* Raduski 1956 - [844]
* Salvaggio 1960 - [977]
* Schmid, H.R., Frede-Niggli, ON THE EGGS OF *DROPOPHIL*
The following table presents the effect of 10, 15, 20 and 25 r.;
St. Arnaud, W. RADIATION:

1228 In *Habrotrocha oogonemis* 1 after passage of the egg th

Let's assume that the experiment was not done under any specific conditions or with any specific species. If there were no great fluctuations is it possible to determine the first cleavage division to the third cleavage division div

* Stone et al. 1964 - [927]
* Towin 1960 - [900]
* Tolcmus and Adamson 1965
* Tolcmus and Adamson 1965
* Tolcmus and Vogel 1963
* Tolcmus and Devine 1954
* Tolcmus and Wright 1966

290
SIV GESCHLECHTSUBGEBUNDENE 
MiKOPIHA MEILOGASTER NACH 
RREPRODUCTION RATE FOR REPRODUCTIVE SEX-BOUND 
SPERMATOZOOID AFTER IRRADIATION IN AIR AND 
WATER was determined on sperm of 
which fertilized 52 to 24 d after 
for lethal and of 0.75% for semi-
and 0.0% semilethal factors were 
recorded on the mature sperm than 
with nitrogen with the same dose 
of 2.0% lethal and 0.2% semi-
and 0.0% semilethal factors. 
Thus, the result of the formation of 
reproductive semen as in air and 
water. (auth.)

"MIKOPIHA COCCTES."

* In MIKOPIHA COCCTES, 
* the cocctes with air 
  bound both in 
  in about 10 min., 
  in the proportions of 
  the stages of 
  the cocctes and 
  the cocctes of MIKOPIHA. (auth.)

TESES, UNIV. TEX., PUBL., BID.

while those in stage 14 were 
spires in the origin of dominant 
while mitotic cells are not 
affected at stage unless may occur 
and inversion heterozygotes. This 
lethality, 
coctes of MIKOPIHA appeared 
"MIKOPIHA COCCTES."

Genetics 40 (1960)

^COCTES of MIKOPIHA MEILOGASTER 
There is evidence for the 
meiosis between sensitivity changes, 
1960)

* Passonneau 1964 - [1221]
* Ray 1957 - [975]
* Ray 1958 - [976]


Male MIKOPIHA MEILOGASTER were irradiated with x-rays. The effects of different wavelengths on spermatozoides in terms of diotomic bridge formation were investigated. The chromosomes most frequently involved in bridge formation were those of medium length, but not the longest. Diotomic bridges, i.e., those that involve fragments, are far more frequent than proximal ones. The number of diotomic bridges longer wavelength is 3.5 times greater, but as pointed out in the discussion, the ion density at 200 keV, \( \lambda = 0.66 \text{ Å} \) is 5 times greater than at 100 keV, \( \lambda = 0.41 \text{ Å} \).

* Rogers and Barret 1957 - [928]
* Raden 1958 - [944]
* Särkijä 1960 - [677]

1228 Schinz, H. R., Pitz-Müller, H., Frey, E. EFFECT OF ULTRA-HARD RADIATION (51-MeV-BETA- 
ON THE EGGS OF MIKOPIHA MEILOGASTER. EXPERIENTIA 8 (1952) 10-8. (In German)
The following \( D_{1/2} \) 's were determined for MIKOPIHA MEILOGASTER eggs of 3-, 4-, 5-, and 7.5-h age, respectively; 200, 400 and 825 r for 180-keV x-radiation; 200, 1255 and 1080 r for 3-MeV electrons; and 271, 117 and 1167 r for 51-MeV x-radiation. Lethal-dose curves are plotted. Reasons for the lower biological effectiveness of the hard 51-MeV radiation are discussed. (NIMA 6: 5096, 1968)

1229 R. Amend, W. RADIOSENSITIVITY OF THE UNFERTILIZED HAMOBRAON EGG DURING MEIOSIS AND 

In HAMOBRAON oogenesis is arrested near the end of the first mitotic division, and mitosis continues only 
after passage of the egg through the ovipositor. Stage of meiosis or mitosis can be related to time after 
laying, and the radiosensitivity of division stages can be determined from the hatchability of eggs treated 
at known intervals after oviposition. Eggs from virgin females were collected as soon as laid and kept at 
20°C. At intervals after oviposition, eggs were either fixed for cytological examination or given 500 r of 
\( x \)-rays (ca. \( D_{1/2} \) dose for unfixed eggs) for hatchability testing. The "age" of each egg (oviposition to 
fertilization or irradiation) is known to within 1 min. The results indicate that (i) eggs just before or just 
after oviposition are about equally radiosensitive; (ii) the mitotic stages from the second stage to aspilar 
indicate no great differences in radiosensitivity; (iii) the pronuclear stage is much more radiosensitive 
than is prophase of the first cleavage division, and (iv) there is a progressive increase in 
radioactivity from the first to the third cleavage division.

* Stone et al, 1954 - [927]
* Strunakov 1960 - [569]
* Tahmizian and Adamson 1950 - [1429], [1299]
* Tahmizian and Adamson 1953 - [1293]
* Tahmizian and Vogel 1958 - [648]
* Tahmizian and Derigs 1966 - [1327]
* Tahmizian and Wright 1966 - [1329]
Tazima, Y. RADIOBIOLOGICAL STUDIES ON THE SILKWORM. I. X-RAY IRRADIATION DURING PUPAL STAGE AND SENSITIVITY OF GERM CELLS. Papers from Coordinating Committee for Research in Genetics 2 (1951) 53-62. (In Japanese, with summary in English)


Tazima 1957 - [941]


Tazima, Y. CHANGES IN SENSITIVITY OF SILKWORM GERM CELLS TO X-RAYS WITH DEVELOPMENT. Radiation Res. 9 (1956) 193.

The sensitivity pattern of the germ cells to x-rays was studied by irradiating successive stages of genetogenesis in both sexes of the silkworm. The germ cells of this animal develop almost synchronously with the development of the parent, so that they may be estimated by the developmental stages of the parent. Wild type females and/or males were irradiated with 260-600 x-rays at several stages of the parent and were mated to non-irradiated parents, and the numbers of eggs laid, of unfertilized eggs, and of eggs that succumbed at several embryonic stages were recorded. Irradiation of the females with 1000 r gave no marked changes in sensitivity among different stages of the germ cells, but with 2000 r yielded a remarkable decrease in the number of eggs laid in early irradiated groups. Evidence of late embryonic lethals increased gradually in the latter half of the pupal period as parents grew older. Male germ cells, however, responded quite differently. A markedly sensitive period was revealed in the early fifth stadium when the germ cells are markedly in early spermatocyst. Irradiation at other stages with the same dose was less deleterious, which indicates that the spermatogenesis, spermatid and mature sperm are fairly resistant to x-rays. The results are mostly consistent with those obtained in Drosophila by many workers. Differential incidence of eggs succumbing at various embryonic stages suggests a theoretical explanation of the differential sensitivity of germ cells to x-rays.


The use of silkworms is advantageous for analysing mutation response (sensitivity and mutability) of spermatogenic cells with some precision since most of the germ cells develop almost synchronously with the development of the parent to both male and female. X-irradiation was administered to male and female germ cells of silkworm at duplicate stages from larval to post-pupae at 200, 500, 1000, 2000, 4000 and 4000 r and mating was made to non-irradiated double recessive pg pg parent. Response patterns were determined with respect to visible mutation rates at marked loci and dominant lethal mutation rates. In treated males, visible mutation rates showed their peak on the 6th day of stadium 5 (larva), i.e., mostly at the spermatocyst stage; dominant lethals reached a maximum on the 3rd day of stadium 5, approximately at the spermiogonic stage, which coincided with marked damage to germ cells. The irradiated female germ cells showed nearly the same mutation rates at relatively low levels throughout various stages of oogonies before mid-pupal stage, after which a sudden increase in mutation rate brought it to the same level as the peak in the male germ cells. The induced visible mutation rates per r were several times higher in spermatogonial and 10 times higher in mature sperm than corresponding Drosophila values. (from abstr.)

Tazima and Onimaru 1958 - [1072], [1073]

X-RAY IRRADIATION DURING MIPA
Committee for Research In

STE. 12. ON THE SENSITIVITY
(Sch.) J. beta. Ed. Tokyo 21

IVITY TO RADIATION OF SILK-
L. Jap: L. Genet. 26: (1937)

THE GERM-CELLS OF THE
(67) 76-S. (In Japanese)

GERM-CELLS. Nihons. Nat.

X-RAYS WITH DEVELOPMENT.

1257 WELBUCHE, I. J., AND CURRUS, W. L. THE EFFECT OF X-RAYS ON THE DROSOPHILA TESTIS AND A METHOD FOR OBTAINING SPERMATOGONIAL MUTATION RATES. PROC. NAT. ACADEM. WASHINGOM 45 (1937)

Histological observations were made on the testes of irradiated adult Drosophila males. These experiments indicate that both secondary spermatagonia and young spermatocytes are sensitive to the killing effects of X-rays. The destruction of these sensitive cell results in a period of temporary sterility following irradiation of adult males. Therefore, this sterile period can be relied upon to separate cells irradiated at spermatogonia from those irradiated at a later spermatogonic stage. It follows that radiation-induced spermatogonic mutations, uncontaminated by mutations at later stages in spermatogenesis, can be obtained from irradiated adult Drosophila males in much the same way that they have been obtained from male mice. (auth.)

Whiting 1936 - [396]

Whiting 1936 - [240]

Whiting 1936 - [142]

Whiting 1936 - [39]

Whiting and Arwood 1936 - [39]

Whiting and Murphy 1936 - [142]

Whiting and Murphy 1936 - [142]

Witte and Sigmund 1936 - [13]

Yanders 1936 - [13]

Zirkle and Parrish 1936 - [83]

I-C+4 LETHAL EFFECTS


Описанные опыты, проведенные с целью установления дозы гамма-облучения, необходимой для позитивного удвраения количества помелов относящихся к гаметам, показали высокую эффективность дозы 15 ки. Смертельной дозой следует считать дозу не менее 340 000 р при данной мощности
Experiments were carried out to find the dose necessary for killing silkworm pupae at the cocoon stage. Spruce (May-June) pupae were exposed to radiation from a 15 C Co60 source. The lethal dose was found to be <2400 r at a given dose rate. Pupae younger than 5 d were found to be more susceptible to radiation than older ones, the lethal dose of 2400 r needing to be increased to 3600 r for older pupae. For irradiating live pupae of different maturity a dose of 3400 r should therefore be applied. Gamma-radiation used for killing the pupae was found not only to sterilize them but also to make the pulp substance unsuitable for developing microorganisms. The solubility of saccharin in irradiated cocoons decreased slightly; from 10.11% of controls (five cocoons) the values dropped to 8.80% after irradiation by 2400 r, and 8.22% after 7400 r.

A Van de Graaff accelerator was used as electron source. Insects such as Tribolium confusum and Sitophilus granarius (L.), which infest flour and wheat respectively, were studied. An electron dose of 10^4 r sterilized eggs of the confused flour beetle and the granary weevil; the same dose prevented the adults from reproducing. A dose of 5 x 10^4 r proved fatal to adults of both insects. Wheat was damaged by a dose of 10^5 r which allowed it to germinate but inhibited further growth. A slight change was detected in the taste of bread made from irradiated flour.

A Van de Graaff 2-MV electron accelerator was used to irradiate test lots of 50 adult granary weevil, Sitophilus granarius, in 5-litre petri dishes containing 30 g Cornell 595 wheat of 18% moisture content with various doses of accelerated electrons. After the adults were placed in the petri dishes, similar test lots of flour beetles, Tribolium confusum, each containing 100 adults, were treated with various doses of accelerated electrons after allowing 3 d for the adults to oviposit. A dose of 10,000 r sterilized flour beetles and granary weevil eggs and prevented adults from reproducing. Thirty per cent of flour beetles and 10% of flour beetles immediately after treatment, whereas a dose of 5 x 10^4 r was lethal to 10% of flour beetles immediately after treatment. A dose of 2 x 10^4 r was lethal to 2% of adult flour beetles 1 week after treatment; and a dose of 1 x 10^4 r was lethal to 2% of adult granary weevils one week after treatment. Doses exceeding 10,000 r were detrimental to wheat seed. Cornell 595 wheat and whole wheat flour were irradiated with a dose of 5 x 10^4 r. Preliminary baking tests indicated a change in taste of head, but was not undesirable.

A Van de Graaff 2-MV electron accelerator was used to irradiate test lots of 50 adult granary weevil, Sitophilus granarius, in 5-litre petri dishes containing 30 g Cornell 595 wheat of 18% moisture content with various doses of accelerated electrons. After the adults were placed in the petri dishes, similar test lots of flour beetles, Tribolium confusum, each containing 100 adults, were treated with various doses of accelerated electrons after allowing 3 d for the adults to oviposit. A dose of 10,000 r sterilized flour beetles and granary weevil eggs and prevented adults from reproducing. Thirty per cent of flour beetles and 10% of flour beetles immediately after treatment, whereas a dose of 5 x 10^4 r was lethal to 10% of flour beetles immediately after treatment. A dose of 2 x 10^4 r was lethal to 2% of adult flour beetles 1 week after treatment; and a dose of 1 x 10^4 r was lethal to 2% of adult granary weevils one week after treatment. Doses exceeding 10,000 r were detrimental to wheat seed. Cornell 595 wheat and whole wheat flour were irradiated with a dose of 5 x 10^4 r. Preliminary baking tests indicated a change in taste of head, but was not undesirable.


Further information on the effects of accelerated electrons on insects which infest wheat, flour and beans is presented, as well as information on the method used to calculate dosage, penetration of electrons into wheat and flour, rate of treatment of products, cost of electrical energy for a given dose in rep., distribution of current density, calculation of the temperature rise in a given sample, and a review of literature on the effects of accelerated electrons on vitamins and enzymes. (from auth. conclusion)


Further information on the effects of accelerated electrons on insects which infest wheat, flour (see Part D), and beans is presented. An electron dose of 10,000 rep proved lethal to 100% of adult bean weevil (Acanthoscelides obtectus Say) in tests on infested Michigan navy beans. The methods are described which had been used to calculate dosage, penetration of electrons into wheat and flour, rate of treatment of product, cost of electrical energy for a given dose in rep., distribution of current density, calculation of the temperature rise in a given sample, and a review of literature on the effects of accelerated electrons on vitamins and enzymes is given. The use of accelerated electrons to stop adult insects from reproducing and to sterilize insect eggs in wheat, flour and beans is concluded to offer promise for insect control; the need for further research is stressed before the process can pass from the experimental to the industrial stage.

Baldwin, W. F. SIMILARITIES IN KILLING BY HEAT AND BY X-RADIATION IN THE INSECT DAELOPODUM TUSCUMERIUM (ZETT.). Radiation Res. 1 (1934) 68-70.

Parallels in response to heat and to x-radiation were shown in the insect D. tuscumeri (Zett.). The immediate consequence of high doses in both cases is a coma from which the insects may recover, to the later of the delayed effects. Tolerance diminishes with age; prior conditioning with moderately high temperatures increases female tolerance; diploid males are more resistant than haploid males; sharp break was found in curves relating dose and effect. All these observations are true for both sexes. (auth. summary)

(An earlier abstract was published in Radiation Res. 1 (1935) 219.)

* Baldwin & Nattrass 1937 - (1365)

* Baldwin & Nattrass 1938 - (1366)


Preliminary laboratory tests in insects on the value of y-ray treatment against wood-boring insects are summarized. Tests were carried out on Lyctus brunneus Staph., Anobium punctatum Dep., and Xestobium ruinicola Dep., removed from wood or in samples approximately 1 in thick. A Co source was used. Eggs of Anobium and Xestobium irradiated within 1-4 d of being laid were killed by exposure to a dosage of 4000 r but the mature eggs required 6000-6800 and over 10,000 r respectively. Some evidence was obtained that the larvae which hatch from eggs irradiated at much lower dosages do not survive. The development of Lyctus larvae was arrested by treatment at 8000 r., but high doses were needed to produce rapid mortality. An apparently similar reaction was observed in Anobium larvae. Irradiation of Lyctus adults at dosages up to 4000 r did not inhibit oviposition, but no fertile eggs were laid by females of any species following irradiation of both sexes at 8000 r. Adults of Xestobium remain within the timber for several months before emerging from it, and this may be of importance in relation to the period during which timbers containing both adults and larvae could most effectively be irradiated. Further work with this species is in progress.


Work is described on Xestobium ruwicola Dep., Anobium punctatum Dep., and Lyctus brunneus Staph., the last being easily reared in the laboratory. A Co source was used. Irradiation ranging from 50 r/min
to 1200 and 1300 r/min. The effective lethal doses required for the different stages of the life cycle may be summarised as follows: Eggs: newly laid = 4000 r (Anobium and Xestobium); mature eggs = >32 000 r (Xestobium). The resistance of Anobium and Xestobium eggs increases with their stage of development, as in Drosophila. Larvae: Development is arrested at doses of 8000 r (Lyctus), 6000 r and over (Anobium). Paper: Little data are so far available but normal development is possible after irradiation at 4000 r (Lyctus). Adults: Egg-laying can occur after irradiation up to at least 48 000 r (Lyctus) but the eggs are sterile after both sexes have been irradiated at a dosage of 8000 r (Anobium, Lyctus, Xestobium). The use of x-rays for the destruction of mature eggs and of larvae offers little hope of practical application but the sterilization of the adults of all three species can be achieved at much lower doses.


1252 Hassett, C. C., Jenkins, I. (1960) 43-56. Lethal doses of high energy and other ionizing products used in the last two developmental stages, which are given for Artigara domini. TRIBOLOID species vary, doses in relation to the order of 10^3 lower doses to prevent each species are possible. (See also Report 109, Am.)

1253 Hassett, C. C. LETHAL Doses, A brief informative survey, Laidinmaps, September 2011, 3 Various processing units at.

1255 Hetzenhal, G., Clark, L. METAPHASE WITH LOW. Studies were made on the (124 kV) and with high vo techniques previously dev in the first series of experlarval stages when the oes Identical, survival follow viability was about 6% of for of that found by A. K. In females which were mature receptive lethal were pre unamated females are so v to dominant lethal.

1256 Olden, K. A. ELECTRONIC STERILIZATION OF FOODS. Research 6 (1953) 376-385. A summary is given of the basic facts emerging from work done on electronic sterilization of foods. High-energy electrons and x-rays from radioactive sources were used. Some information on the doses necessary for destroying bacteria, and insects and their eggs are given. Whereas x-rays are not handicapped by very limited penetration, their use necessitates extensive safety precautions, and the cost of their application is very high. (See abstract in Food Sci. Abstr. 26, 3 (1947) 338, no. 1947)
different stages of the life cycle (Xenobium), mature eggs increase with their stage of development. After ejection to at least 48,000 r (Lytacron) and 60,000 r (Anisoplia, Lyctus), use of γ-rays for the sterilization of the adults of the silkworm (Bombyx mori L., L.) in English.


Lethal doses of high energy γ-radiation were studied for a species of insect pests of food, clothing, wood and other stored products. Doses of 1000 r/h from a TeU238 source and 183,000 r/h from a Co60 source were used; the latter was necessary since otherwise the time required for a lethal dose extended over several developmental stages, which show a different necrosis and mortality. Lethal doses were given for Antipas heptodon, Lasioglossum sacrarium, Sitophilus oryzae, Rhyzopertha dominica, Tribolium confusum, Lyctus planicollis, Drosophila melanogaster. While susceptibility of species varied, doses in excess of 50,000 r were required to produce death. Probable dose for insect destruction is of the order of 100 r, fast-falling doses (50,000 r) can be used to stop damage by heavy infestations, lower doses to prevent reproduction. Lactobacillus in the high doses were extremely resistant for the first two days, radiation having the effect of temporary retardation. Sources of such radiation intensities could be prepared from fission products at negligible cost.

(See also Report 149, Army Chemical Center, Md. Chemical Corps Medical Labs.)


A brief informative survey of work on the effects of various doses of γ-rays on 6 insect species (adults of L. sacrarium, S. oryzae, T. confusum and R. dominica, and on larvae and adults of P. heptodon). Various processing units and sources of radiation are mentioned, and some cost estimates given.


Studies were made on the survival of haphazard eggs treated with low voltage (164 KeV) and with high voltage (60 MeV) X-radiation. Doses ranged from 100 to 1750 r. Standard techniques previously developed by A.R. Whiting were used throughout. Since females were not mated in the first series of experiments, parthenogenetic development occurred among the surviving eggs up to larval stages when the observations were discontinued. The curves for low and high voltage are practically identical, survival following treatment with 400 r was 50% for high voltage and 5% for low; at 1100 r the viability was about 0% for both types of radiation. The curve for low voltage is essentially a confirmation of that found by A.R. Whiting. Other studies were made of eggs treated with low voltages but laid by females which were mated following irradiation. Under those conditions it would be expected that if recessive lethals were present, viability should be increased. Since the curves for eggs from mated and from unpaired females are so very nearly alike, it is tentatively concluded that eggs of this type are to be attributed to dominant lethals.

Jeffries & Connell 1958 - [1941]

Kneawoorthy 1956 - [1941]

King 1950 - [1941]

King 1954 - [1941]

King and Wilcox 1965 - [1941]


Kukolki kugidov vyzoporodna podvzriedna gama-vizgrobyvshim. Kukolki rezyo vyzoporodnyx karakterizuetsja razlichnymi sostoyannostyami i gama-vizgrobyvshim. 100% dvojnoe dvojnoe sostavlyaet dla I-first 200 000 r, dla II-2nd 150-180 000 r, dla III-3rd 100 000 r. Po naschelnaceh dvojnoy kukolki postojno perestoj reakcionnoye sotveyditsy, no vremena krukii i unoyeonitsy v noe. Vzimta oopera zona unoyoinitsy sotve doju i dojuy. Gama-vizgrobyvshim nazvaniy lezadvazhi yazplakno.

Kukolki kugidov vyzoporodna podvzriedna gama-vizgrobyvshim. 100% dvojnoe dvojnoe sostavlyaet na 0.6 r, na 0.75 000 r, na 1.0 000 r. Po naschelnaceh dvojnoy kukolki postojno perestoj reakcionnoye sotveyditsy, no vremena krukii i unoyeonitsy v noe. Vzimta oopera zona unoyoinitsy sotve doju i dojuy. Gama-vizgrobyvshim nazvaniy lezadvazhi yazplakno.

Na osnovanneh nakazhnoh nezholy nozhlyoma v yozhny il yozhnoy ko nozavolnye, a kukolki kugidov podbraznyy a dvojnoe dvojnoe 200 000 r vyzoporodna podbraznyy kukolki kugidov podbraznyy a dvojnoe dvojnoe 200 000 r.

Silkworm pupae are susceptible to γ-radiation. Pupae produced in different seasons are characterized by different resistances to γ-rays, the lethal dose (LD50) requiring 290,000 rep for the first, 150-180,000 rep for the second and 100,000 rep for the third season. On receiving a lethal dose a pupae gradually ceases to respond to external stimuli and, in time, turns black and loses weight. The weight loss and γ-dose are related linearly. Gamma irradiation brings about a slight delay in pupa development. Observations collected over 6 months suggest that a lethal dose of 200,000 rep also ensures preservation.

1256 Langendorf, H., Sammer, K. DIE ABSTÜTzung VON DROSOPHILA-EIERN DURCH ENERGIEREICHEN STRAHLEN ALS BIOPHYSIKALISCHES PROBLEM (The killing of Drosophila eggs by high-energy radiation, treated as a biophysical problem). Strahlentherapie 89 (1940) 316-26. (In German)

The biophysical aspect of the influence of the biological variability on the shape of the killing curves was studied in a series of experiments with 1 to 4-h-old eggs. Results pointed to a high degree of variability in younger (above 1 h-old) stages of egg development and proved that many elementary rays were required for the killing action. Irradiation with gamma-rays that showed the damaged part of an egg is comparatively large relative to the egg volume.


Embryos of the cockroach, Periplaneta americana, at an average of 14 d, were irradiated with 50 and 100 kV filtered x-rays, of effective λ 0.479 and 0.663 Å, and also with fast neutrons of energies between 2 and 10 MeV. X-ray doses varied between 52 and 5060 r and dose rates between 25 and 100 r/min; neutron doses between 41 and 4428 rep. After irradiation, the embryos were incubated at 27°C for 70 d. The fraction of nymphs which hatched completely was determined and compared with non-irradiated controls. Details of these experiments are described in Cember’s thesis on file at the University of Pittsburgh. The theoretical implications of the results are discussed. (From abstract.)


This thesis was published in Genetics, see under Lee, W. R. 1956. An outline of this paper is published in the Abstracts of the Genetic Society of America, 1956, no. 25, see under Lee, W. R. 1956.

Lee 1956 - (1956)

Lee 1958 - (1958)


Embryo LD50 (30 d) was found at 460 - 460 r: LD34 (33 d) at - 200 r. For 600 - 7000 r decreasing development with subsequent deterioration were observed. Neuroblasts recovered from neutron inhibition (after 600 - 2000 r) divided at approximately the same rate as cells in unirradiated embryos. The neuroblasts were fairly "resistant" to permanent inhibition.


Jusqu'à la dose de 2000 r, les rayons X d'Ulbricht n'ont aucun effet léthale chez Callandra granari a L. l'insecte adulte. Au delà et jusqu'à 25 000 r, la survie moyenne des populations est le même quelle que soit la dose reçue. Les irradiations supérieures à 25 000 r provoquent une mortalité plus plus rapide des insectes. On note une inhibition irreversible de l'appareil reproductive. Il semble y avoir aussi des modifications de l'appareil digestif et du système nerveux.

1261 Muller, H. J. THE CH. p.32-5 in "International Venice 22-23 June 1951"

Data are reviewed from of an exposed general.

1262 Rogers and Bortel 1952

1263 Rogers and Hillberry 1952

1264 Schindl et al. 1952 - 1


Time of action studies natural populations, pop were found to be select obtained from a laboratory, the mean was 10 larval days, 6 larval days was 5.5 to 15 days, the effect was combined in the early stages in the definition of the action of .

1266 Steger, R. EMBRYON. FLIEGEN NACH BESTRA. mena Drosophila pt. 6 Los Alamitos Scientific I.

A quantitative study was for isolating the occurs exposure to various radi a count made of the relax. it is suggested that have resulted from 2th shown to be only 0.8 to fraction. (NEA 12: 10)

1267 Segahara, T., Horikawa BB, MELANOCASTER

1268 Sonarokov, G. V. THE RADIATION CONDITION

The effects of ionizing Callandra granaria, and in sar with varying injury. Data are taken (1954).


Egg mortality was from x-irradiation. It seems genetic radiation data later. This higher "do nent" if the rate were

Data are reviewed from a series of studies that demonstrate the permanent damage caused to individuals of an exposed generation of Drosophila by irradiation of their somatic cells. (NSA 15; 3946 (1961))

Rogers and Bouswell 1957 - [222]

Rogers and Hiltschey 1960 - [485]

Schino et al. 1982 - [1220]


Time of action studies were made on eggs, larvae, pupae and adults. Lethal effects were studied on natural populations, populations reared in the laboratory, and others subjected to X-rays. Lethal effects were found to be selective, depending on the stage under investigation. The spontaneous lethals obtained from a laboratory stock were effective in the larval stage. The lethals from natural populations were distributed, in respect to their time of action, as follows: 3 egg lethals (E), 19 larval lethals (L), 18 larval (L), 6 larval-pupal (P/L) and 6 pupal lethals (P). The distribution of the X-ray-induced lethals was: 7 E, 5 E/L, 12 L, 1 P/L and 3 L. These data, though showing no significant differences between them, when combined with similar data from Roga show a significantly larger number of lethals acting in the early stages in the X-rayed group as compared with the two non-irradiated groups. A brief description of the action of X-rayed lethals is given.


A quantitative study was made of the effectiveness of x-radiation produced by 180 keV and 31 MeV sources for inducing the occurrence of dominant lethal factors in the sex cells of male Drosophila. Following exposure to various radiation doses the male Drosophila were mated with previously unirradiated females and a court made of the ratio of hatched to unhatched eggs which resulted. A total of 84,589 eggs were counted. It is suggested that the enormous increase of unhatched eggs between days 8 and 12 may not have resulted from lethal factors, but from ascioperamia induced by radiation. The 31 MeV beam was shown to be only 0.6 times as effective as the stable voltage generator in producing dominant lethal factors. (NSA 12: 16048, 1958)


The effects of lethal radiation on adult insects were studied following the exposure of the beetles, Calandra granaria, during the developing stage to various doses of Co₀ radiation under normal conditions and in air with varying amounts of oxygen. Death of the insects served as the indicator of radiation injury. Data are normalized from these repeated tests in which 25 000 insects were used. (NSA 12: 9578, 1956)


Egg mortality was compared following ejaculation of D. melanogaster sperm 0-04 and 24-48 h after X-irradiation. It seems that sperm ejaculated immediately following radiation are more susceptible to genetic radiation damage than those apparently less mature at irradiation, which are ejaculated a day later. This higher "dominant lethal" rate during the first 24 h would be further augmented by "oviposition" if the males were not allowed to mate before irradiation. (From auth.)

295
Tetkivides et al., 1967 - (1969)

Whiting and Ariens 1955 - (1955)


This study demonstrated that, for x-ray-induced embryo lethals, dominant in haploids, dominant in heterozygotes, and recessive in haploids, still at increasingly later stages, respectively, and that embryo lethals with more than one recessive lethal respond differently in respect to mean stages at death depending on whether the lethals were induced by x-irradiation of oocytes or of spermatocytes. In heterozygotes x-ray-induced lethals appear to be due to recessive lethals seen strictly, and there is no correlation between numbers of lethals present in an embryo and its stage at death, and no cumulative effect. In spermatozoon evidence suggests induction of translocations and inversions in addition to true recessive lethals. The significant positive correlation between numbers of lethals and stages at death may be due to some additional factor. (auth.)

1271 Bochow, V., Libet, H., GASTER NACH EINMAIL Drosophila melanogaster 567-72. (In German) “Berlin-wild” strain of D. The techniques used are shown. Since male court be much more radiation-complied with the non-linear salinity in the mla 20,000 r for the male.


Male Drosophila melanogaster (Oregon-R) were irradiated with 3000 r of 0.6 MeV electrons and mated to Melter-R females. The ensuing F1 female progeny were collected at 15-24 hour intervals and tested for the presence of sex-linked recessive lethal mutations in the irradiated X-chromosome. The probability that an emerging female possessed a lethal X-chromosome was found to increase significantly in each successive period of collection. Assuming a linear response, a weighted linear regression analysis of the data led to the equation \( Y = 5.542 + 0.338 X \), where \( Y \) is the expected percentage of lethals and \( X \) is the exponential collection period. These results suggest that newly-induced recessive lethals prolong development in heterozygotes, and that at least part of the viability impairment of heterozygous lethals is a reflection of decreased developmental rate. (auth.)

I - C - 5 LONGEVITY AND RECOVERY PHENOMENA

Survey


Excellent review article, dealing with lethal effects, the effects of radiation on development, reproduction, longevity and miscellaneous responses. Separate sections are devoted to genetic effects, competitive biological effectiveness, and radiation disinfection. 234 references are given. Results for the whole field are summarized in 5 invaluable tables, sources being cited throughout.

(An abstract of a review paper “A review of the uses of ionizing radiation in the disinfection of food” was published in Bull. ent. Soc. Am. 2, 3 (1956) 26, abst. 19)


Control survival curves were obtained for some 14,000 flies (D. melanogaster), and the median survival time for males and females was found to be 44 and 51 d. One-day-old imagines were given single treatments with doses ranging up to 225 r of Co60 γ-rays. Life-span shortening was found to be proportional to dose, when the median survival time of the experimental group was subtracted from that of the control, and the difference was expressed as a percentage of the control life span. A series of flies (both sexes) ranging in age from 1 through 20 d were given a single dose of 75 r. There was no increase in radio-
sensitivity with age as the dose at 10 d of adult age commenced on their first dose experiments had rig and the situation becoming in the adult insect.

(Absent of paper present)

1271 Bochow, V., Libet, H., GASTER NACH EINMAIL Drosophila melanogaster 567-72. (In German) "Berlin-wild" strain of D. The techniques used are shown. Since male court be much more radiation-complied with the non-linear salinity in the mla 20,000 r for the male.


Male Drosophila melanogaster (Oregon-R) were irradiated with 3000 r of 0.6 MeV electrons and mated to Melter-R females. The ensuing F1 female progeny were collected at 15-24 hour intervals and tested for the presence of sex-linked recessive lethal mutations in the irradiated X-chromosome. The probability that an emerging female possessed a lethal X-chromosome was found to increase significantly in each successive period of collection. Assuming a linear response, a weighted linear regression analysis of the data led to the equation \( Y = 5.542 + 0.338 X \), where \( Y \) is the expected percentage of lethals and \( X \) is the exponential collection period. These results suggest that newly-induced recessive lethals prolong development in heterozygotes, and that at least part of the viability impairment of heterozygous lethals is a reflection of decreased developmental rate. (auth.)

1273 Clark, A.M. SOME EFFECTS OF IRRADIATION ON DROSOPHILA MELANOGASTER FEMALES. Invermere 1960. Some effects of irradiation on Drosophila melanogaster females which is shortened in proc pupae which cannot be used as adult life span is measure of onset of death within longer time for smaller reduction in life span.

1274 Clark, A.M. THE MORTALITY OF HABROBRACON. Invermere 1960. Haplod males, diploid females to Habrobraron, (Habrobracosen) white pupae in and diploid males fed on larvae of sex but not to genome mutations during adult 1 than comparable diploid relative to their controls are equal to controls in these adults, however,

100
DEATH OF X-RAY-INDUCED HAPLOIDS. Radiation Res. 2, 2

The rate in haploids, domine in the first day, respectively, and haploid deuterons at death decreased in all stages and stages at death decreased in all stages in every stage, and there is no correlation between the rate of death and the number of stages at death may be due to these.


A review of development, reproduction, genetic effects, comparative results for the whole field of the distribution of foods.

DIPLONOMAGASTA, and the median survival times of those given single treatment were found to be proportional to the number of controls, and a series of files (both sexes) were observed in radiosensitivity with age as the life expectancy diminished. Additional groups of flies received large single doses at 10 d of adult age. Comparable groups received daily treatments of the same total doses commencing on their first day and ending on the death day. At all dose levels the flies in the fractionated dose experiments had significantly longer survival. This is considered to be a true recovery phenomenon, and the situation becomes unique when it is recalled that somatic cell division is almost completely lacking in the adult insect.

(ABSTRACT OF PAPER PRESENTED BEFORE THE RADIATION SOCIETY, ROCHESTER, N.Y., 13-15 MAY 1957)


"Berlin-Wild" strains of D. melanogaster aged 10-48 h were subjected to 40,000 r, 70,000 r, and 100,000 r. The techniques used are described. 14,000 adults were investigated. Male mortality was higher at all doses. Since male controls show much greater average longevity than the females the male adult must be more radiation-sensitive. The life span of the female at 40,000 r is extended significantly compared with the non-irradiated controls. Whereas the drop in life span with increasing dose follows a linear relation in the male, this is not the case for the female. The LD50 is 15,000 r for the female, and 30,000 r for the male.


A technique was employed permitting partial x-irradiation of larvae, using eye facet number as a biological dosimeter. Partial irradiation shows more effect in terms of lethality. A general trend in eye facet reduction was noted with increasing dosage in all types of irradiation. Males show a greater reduction than females. Differences between males, females, and post-irradiation with regard to facet number are significant only in the females when an analysis of variance test is used, but the test is not used in the group tested (survivors). It is concluded that the entire genome of the stock used is reacting in an aberrant fashion to the irradiation per se since great fluctuations are not observed in all experimental groups but only in controls, with regard to eye facet number. Standard errors in experimental categories is 0.93 for 4 and 0.66 for 8.


Habrobracon females when exposed to x-rays as larvae, pupae, or adults show a decrease in adult life span which is correlated in proportion to the amount of radiation absorbed. Radiation damage to larvae and pupae which cannot be detected simply by observing the incidence of adults that emerge, is revealed when adult life span is measured. Groups irradiated as adults show no immediate decrease in survivors. The time of onset of death within the group depends upon the amount of radiation absorbed. Death is delayed for a longer time for smaller doses. Although adults will survive a dose of 500,000 r, or at 800,000 r a decrease in life span.

Clark 1960 - [1961]


Haploid males, diploid males and diploid females of the wasp, Habrobracon sp. (an Indian species related to Habrobracon lugdunensis), show a decrease in adult life span following exposure to x-rays as larvae, pupae, or adults. The median life span for non-irradiated adults was 58 d for haploid males and diploid males fed on honey-water, 92 d for diploid females fed on honey-water and 49 d for diploid females fed on larvae of the Mediterranean flour moth, Etephora. This difference in life span related to sex, but not to genome number, indicates that the aging process is not due to an accumulation of somatic mutations during adult life. Haploid males exposed as adults to 1000-5000 r have a shorter life span than comparable diploid males. Diploid males and diploid females show similar decreases in life span relative to control groups. Pupae after exposure to 1000 r and 1500 r and larvae after exposure to 2000 r are equal in controls in post-embryonic survival and in ability to develop into structurally normal adults. These adults, however, show a decrease in life span. Diploid males resulting from irradiated larvae or...
pupae show a decrease in life span that is smaller than comparable haploid males but similar to diploid females. Radiation-induced decrease in life span is markedly influenced by genome number but not by sex. This indicates that in contrast to the normal aging process, the decrease in life span by X-rays is due to damage to the genetic material.


The author reports observations made over a period of 2 years which indicate that the life span of a given number of flour beetles (Tribolium confusum) can be extended by several per cent by irradiation with γ-radiation. This may be a single exposure of about 5000 r or chronic dosages of about 100 r. The results show that the cumulative effect of chronic irradiations is not equivalent to but less than that due to a single dosage of the same amount. Twenty per cent of the animals receiving the 100 r daily dosage lived more than 450 d. In that time they received 45,000 r, which is more than twice the amount that would have produced complete annihilation in a single irradiation. Organisms which survive a single large dosage of γ-rays appear to have a survival rate superior to that of those that receive no radiation.


Developing individuals of H. angulata were exposed to various levels of beta radiation for 48-h periods just before hatching or during the early larval period. At the highest levels of radiation used, the wasps died before hatching or in the larval stage. At intermediate levels death usually occurred during pupation with a considerable degree of internal co-variation between the extent of imaginal deamination and the amount of radiation given off. At the lowest levels it was apparent that most of the animals attained adult form. The rate of development was somewhat reduced at the highest and intermediate levels but not at the lowest levels. Pupation without cocoon formation was a frequent occurrence at the intermediate levels. Evidence which indicates that irradiated animals reaching adulthood were sterile is presented. (Abst.)

Edman 1950 - [888]

Garsh 1956 - [1512]

Geason and Umam 1956 - [324]


The longevity of heavily irradiated (50,000 - 100,000 r) female wasps (Habocroacon) was determined in the presence of food (green beetler caterpillars) as well as under starvation conditions. An increase in life span of adult wasps irradiated with X-rays was found only under starvation conditions, most pronounced about 100,000 r, and explained by the ineffectiveness of the treated insects. This lethargy is induced by a much lower dose than that required to cause prompt adult death but exceeds doses levels which sterilize adults and kill immature stages. Therefore, if the presence of adult insects is not objectionable, the induction of non-lethal lethargy may be a more feasible technical approach to insect control than quick-killing exposure. It seems likely that the nervous system may be more sensitive to irradiation than has been deduced from morphological studies. (From auth.)


Some aspects of the biology of T. sternale and the effects of single and fractionated doses of γ-radiation (from Co57) on reproduction and larval development are discussed. All doses applied to the larvae adversely affected the reproduction of the resulting adults, but the reduction in population caused by exposure to 4000 r or less may have been due to lowered viability or morphological deformity. Continuous exposure to 5000 r and above inhibited reproduction, but when the dose was divided, the threshold for inhibition was 6000 r. At the lower levels, dividing the dose had no effect. Larval development was delayed more by continuous than by divided doses.

(Earlier work was published in Bull. ent. Soc. Amer. 2, 3 [1956] 17, abstr. 25)

Larsen, W. J., Hoglund ROACH, BLABERUS CRAN. Gravid cockroaches contain from 50 to 1000 r. After were allowed to complete irradiation. Malformation of X-irradiation. Various
radiation but similar to diploid males but not by genome number but not by
male in life span by x-rays is due

TREBLE. Radiation Res. 7 (1957)

It is well known that the life span of a given
60% of the young would be less than that due to a
using the 100 x daily dosage lived in the male until after the age of about 100%. The results

Kroeger, H. EINER ANALYSE RÖTCHENINDIZIERTER MODIFIKATIONEN IM FLÜGELGEWEBER DER MEHL-
VOLLMUTTE EUPHRASIA KÜHNHAEUFLER. ZELLER. (An analysis of x-ray-induced modifications in the vein pattern

Abnormalities in the system of veins in the wings are examined, induced by x-radiation in the last larval
stage. There are 3 types of modifications: (i) additional veins arise in the form of lines between longitudinal
veins, as a splitting up near the edge or as local eye-like doubling. (ii) It is possible that the first 3 of that 
larval stage are accompanied by shorter and wider wings; (iii) reduction of veins results form localized
spinning of two longitudinal veins, which usually happens between the 9th and 10th day, when the wings
are usually smaller than in the normal. On the 3rd of the last larval stage when the pupe spins into the
wing there is a change in metabolism accompanying by low radioreactive. The primary result of irradiation
is disturbance in mitoses. The less sharply form of the wings is due to disorder in spindle directions. The
white significance of the results is discussed.

LaChance, L.E. ENTRÉSIS DE ETHYLENEDIAMINOTETRAACID ACID AND THE EFFECT ON LIFE SPAN
OF INSECTIS. J. Econ. Ent. 46 (1955)

A number of experiments were carried out on the genetic damage induced in the reproductive tissues of
larvae of the egg coincident with metabolic disturbances.

Lamarque, P. STUDY OF RECOVERY AFTER IRRADIATION WITH X-RAYS. J. Chin. Phys. 48 (1951)

Hatching-rate curves of repeatedly x-irradiated eggs of the common silkworm (Bombyx mori) point to the
existence of a recovery effect, the total dose of two irradiations, separated by a time interval, is larger
than the dose of a single irradiation producing the same damaging effect. For a 7-day interval the optimal
recovery is observed when the ratio between the first partial dose and the total dose is equal to 1. Recovery
processes are ascribed to metabolic activities of the cell. (NIA 5: 5492, 1951)

Lamarque, P. LA RESTAURATION EN RADIOLOGIE. Pr. méd. 69 (1952) 1839-41.

Bombyx mori silkworm eggs were exposed to single and fractionated instantaneous doses of up to 2000 r of
x-rays. The effects on recovery, as measured by the per cent of hatching, of placing the eggs in an incubator
or in a refrigerator during the interval between irradiations, of varying the length of the interval, and of
varying the initial dose were studied. The existence of a critical radiation dose for optimum recovery is
discussed. (NIA 7: 1894, 1953)

Lamarque and Gany-Bobo 1956 - [818]

Larsen, W. P., Grundmann, A. W. THE EFFECTS OF X-IRRADIATION ON THE EMBRYOS OF THE COCK-

Gravid oocytes containing developing embryos from 1 to 60 d old were given x-ray dosages varying from
50 to 1800 r. After 30 d embryos younger than 60 d were killed and fixed, whilst the older embryos
were allowed to complete their development. They all hatched normally if older than 30 d at the time of
irradiation. Malformation was found to correspond to the age of the embryo at treatment and the amount
of x-irradiation. Various irradiation effects are discussed.
1225 Lining, K. G., Hammer, B. RECOVERY PHENOMENON AFTER IRADIATION IN DROSOPHILA MELANOCASTER. I. RECOVERY OR DIFFERENTIAL SENSITIVITY TO X-RAYS. Hereditas 43, 3-4 (1950) 59-60.

The results obtained from red versus white chromosomes were not conclusive as regards the Q(2) effect but indicate that the difference between the two strains is due to recovery. Studies with fractionated irradiation at 15 min intervals in air or anoxia indicated that the same response is obtained in both strains. This study, therefore, is discussed in the light of the fact that when half of the treatment was given at anoxia and the other half in air the results were the same as when both fractions were given in air (each fraction being 600 r). This dose, in air, was adequate to block the recovery process. The implications are discussed.


When a dose of 6040 r is given, a dose of 1080 r in the presence of O(2) (air) is sufficient to block the partial recovery mechanism of the chromosomes which is still effective when 24 h are applied under the same condition. In a N(2) atmosphere. The form of the curve indicates that inactivation is the result of multiple hits.

1235 Lining, K. G., Soderstrom, J. RECOVERY PHENOMENA AFTER X-RADIZATION IN DROSOPHILA MELANOCASTER. II. RECOVERY OF RECESSIVE LETHALS. Hereditas 42, 3-4 (1957) 513-70.

The authors examine the relation between recessive lethals and chromosome breaks in D. melanogaster. It is concluded that breakage per se and rejoining by recovery were not the origin of recessive lethals. This conclusion was based on the assumption of the existence of a recovery process after irradiation at anoxia as proposed by Baker and von Hille (1953, 1955). (cf. confirmation by Lining and Hammer, 1957.)


Data presented which still further strengthens the hypothesis of a spontaneous recovery process in sperm irradiated in air. The hypothesis of differential sensitivity to various stages of spermatogenesis was re-investigated. The same technique was used in the establishment of the spontaneous recovery process, i.e., elimination of X- and Y-chromosomes in sperm from X(2) Y(2) males. It is concluded that the high rate of chromosome aberrations induced in stages supposed to be spermatozoids was due to a greater sensitivity. Furthermore, it is shown that the sensitivity in these stages depends on the age of the males at treatment. Hence, the co-variation of a spontaneous recovery and of differential sensitivity in spermatogenesis in Drosophila has been demonstrated.


Males (m) were irradiated in air or in anoxia, and then mated with Muller-5 females. An F(1) test gave no evidence that chromosome breakage or reunion by recovery had a genetic effect. However, the viability of offspring resulting from sperm irradiated in anoxia was greater than after irradiation in air.


Four time intervals were used to test the possible existence of a recoverable mutation process, following irradiation at anoxia. The technique and lethality criteria are stated. A borderline was found for the recovery of potential recessive lethals which occurred between 30 and 40 min after irradiation, and in similar to that obtained for chromosome breaks.


Tests on Musca domestica, Tribolium confusum, and Podosus egeriae.

364

In order to estimate the genetic effects of radiation on longevity, the life span of the offspring from irradiated females and from irradiated males were measured. Controls were measured at the same time. The life span of the male offspring of treated parents lived as long as those from the control when they were kept with males; however, they lived significantly shorter periods than the controls when kept alone, without mates. The male offspring seemed to be more strongly affected by radiation than the female offspring. These results suggest that mutations that have an effect on longevity may be induced by X-rays, but no linear relation between dose and effect was found. (auth.)


It is generally accepted that there should be some specific differences in the genetic effects of radiation on different species. To study this problem, an analysis of the survival rates of different strains of *Drosophila melanogaster* was attempted. Young males of three strains, Canton-S, Oregon-R, and Tokyo, each within 24 h after emergence, were irradiated with 2000 r of X-rays and mated with virgin 3- or 4-day-old females. The progeny were examined by counting daily the number of surviving adult flies until all had died. In a further experiment, the progeny raised from the mating of irradiated females (1000 r) with non-irradiated males were similarly examined. Some differences among strains were seen in these experiments. A differential survival between control and irradiated classes, with a longer survival observed in the control, was found sometimes in two strains, whereas no difference was found in the other strain. However, in cases where no considerable difference was found between control and experimental flies under usual conditions, if they were placed under unfavourable (e.g. crowded) conditions, a difference appeared in preliminary experiments. Further investigations are in progress.


Disposed larvae *Neurothorax vitripennis* provide an opportunity to study recovery from x-irradiation uncorrelated by cell division because during dispausouality all mitotic activity ceases, although metabolism continues. Dispausouality is terminated and cell division initiated by chilling larvae and then placing them at 25°C, whoseupes movement and adult development begin. In the present study dispausing larvae were irradiated with a single dose of 2000 to 5000 r, kept at 25°C for various periods of post-irradiation recovery, and then placed at 5°C for 12 weeks to terminate dispausouality. Following this, they were returned to 25°C and their development observed. The results revealed considerable post-irradiation recovery. For example, of larvae given 5000 r and immediately chilled, only 8% pupated. A post-irradiation recovery period of 5.5h at 25°C enabled 59% to pupate, while a 10-day recovery permitted 87% to pupate. These results were confirmed by split dose experiments in which it was shown that recovery took place between the two. The data demonstrate a marked and prolonged post-irradiation recovery in the non-thriving cells of the dispausing larvae.


The effects of various X-ray doses and ingested radium on the parasitic wasp *Habrobracon* were investigated. X-ray dosages of less than 100 r produced no evident effects, and 140-200 to 190-250 r caused sluggishness from which recovery was noted in about 24 min. Actually, both males and females showed increased life span following X-irradiation. The life span was not demonstrably affected by radium ingestion of 106 and 250 µCi/ml of 16 reference. (NSA 7: 2497, 1955)


Houseflies (*Musca domestica*) and oriental rat fleas (*Xenopsylla cheopis*) were exposed inside an air-conditioned gondola during a balloon flight that maintained an altitude of 76,000 to 81,000 feet for 16 h. The purpose was to gather information on biological damage from cosmic and other radiations near the top of the atmosphere during a well-instrumented flight. Successive generations of the exposed insects
reproduced about normally and no physical abnormalities were noted. Those exposed outside the gonads were killed by the low temperature. (Auth.)


Whole-body x-radiation in a single dose of 30 or 500 r was administered to 8th instar larvae, newly formed pupae, and newly hatched adults. In groups of 50 animals each, 0.6 mm Al, 0.5 mm Cu. dose rate 45 r/min. There was some mortality among the adults, highest within the first 48 h, and a noticeable shortening of the adult life span independently of the irradiated stage. The duration of the pupal stage in animals irradiated at either larval or early pupal stages was shortened to 3 to 5 d instead of the usual 5 to 6 d: the last larval and prepupal stages was also shortened. The cecum cecum complex was missing in the free amino acid chromatograms of irradiated larvae, hence the irradiated animals resembled the larvae produced by old parents. X-radiation of larvae and pupae retarded the development of pigmentation on the adult stage. The white form persisted for about 24 h followed by the bronze-coloured phase for the subsequent 48 h. In some cases this continued for 5 d, whereas normally the black body is formed in 48 h. During this period the exuviation remained soft, since sclerotization is associated with pigment production. Uneven pigment patterns appeared in some adults, the head turning black before the rest of the body.

(Paper presented before the Radiation Res. Soc., Pittsburgh, Penn. 18-20 May 1959)


Eggs, larvae and pupae were exposed to gamma rays from a Ca40 source. Doses below 4000 rad had no harmful effects on the immature stages or on the adult to which they gave rise, and appeared to stimulate development. Seventy-two percent of eggs irradiated at 4000 rad gave rise to adults; emergence of these was delayed by two days, they were deformed and sluggish and few reproducing. Increasing the dose to 8000 rad reduced the percentage of adults to 6 and none of them reproduced. At both doses the effect on larvae was more pronounced with the exception that adult emergence was less delayed. At 2600 rad both eggs and larvae were killed. When pupae received doses of 4000, 8000 and 10000 rad, the resulting adults were severely affected and none of them emerged. The number of F larvae produced were reduced by about 80 and 90%, respectively. A few adults emerged from pupae that received a dose of 18000 rad, but were unable to feed.

* Whatton & Whatton 1946 - [847]


The pterin-protein body in scales of F. rape was granular in the male, while needlelike in the female. Irradiation by 30 r from an active radium-185 source was able to reduce this difference and produced uniform shapes in both sexes by heavy doses. Feeding pears of this butterfly on cabbages supplemented by Ca40 also reduced the difference in the pterin-protein body shape in both sexes.


Cell division preparatory to molting takes place during a fixed period after feeding in the epidermis of the blood-sucking bug Rhodopus proliferus, thus, the insects can be irradiated while all of the epidermal cells are in a resting state, and mitosis can be initiated at any subsequent time by means of a meal. In insects irradiated from the dorsal side of the abdomen with a 2 MeV beam of 8 MeV X-rays (dose 50 000 r), the development of the epicuticular layer is quite normal during the first 46 d after feeding. By the 6th and 7th days, a large number of cells blocked at prophase and metaphase can be found in the irradiated areas, cell degeneration begins on the 9th and 10th days. The "burned" is eventually covered by an undifferentiated


The blood sucking insect Rhodopus proliferus only during a fixed period in the epidermis; this insects is presented from a study in which bones after a blood meal. Photos of larynx radiation damage are


The type of lesions that can be reduced or promoted in the epidermis before being fed.

1303 Bourquin, R. C., Puccioni, R. Radiation Res. 12 (1956) 65.

X-radiation induces pupation of larval age at the time of pupation in the adult organs. The effect is not a sex-specific, but rather the effect of the whole larva, and in general, and not in particular, normal hormonal control. Sex and the time of irradiation. Recent results in morphological d


Grahn, having received doses without in any way interfering emergence were unaffected by


The pupa of Drosophila melanogaster experiments because tissue of 1 and at rest. Irradiation of pure 50 000 r (50 r) and that with intermediate age. Detailed fatt, cells, gonads, cell differen
RADIATION ON THE LIFE CYCLE

The exposed outside the gondola

to 6th instar larvae, newly formed
neural cells, are a mass, 0.8
mm Al. 0.3 mm Ca.

10 May 1959

LIMNOBUIS Z. Bull. Inst. agric.

A. Doses below 4500 rad had no
effect, and appeared to stimulate
the larvae to adults; emergence of these
larvae was delayed. Increasing the dose to
10,000 rad both 5000 rad, the resulting adults
were by about 60 and 80% respectively,
but they were unable to breed.

PEARLE PEPITIN-PROTEIN COMPLEX
of Gobiobio Strophurus

while moorlaleike in the female.

The effects on the body wall of the insect

Grain, having received doses up to \(3 \times 10^4\) rad from Co-60, can be used for rearing C. granaria and C. oryzae, without any way interfering with their development. The yield of progeny, their weight and rate of emergence were unaffected by radiation treatment.

Fritz-Niggli, H. QUANTITATIVE UND QUALITATIVE ANALYSE DER KÖRNERZERSTÖRUNG IM DROSOPHILA-VERSUCH Quantitative and qualitative analysis of rootcut (ray injury) in Drosophila melanogaster. 1932 216-216. (In German)

The range of Drosophila melanogaster represents a good subject for entomological and special meaningful experiments because those is found in the host and as in morphostructural and cytochemical differentiation and test. Irradiation of pupa of various species (2, 10, 22, 29, 40, 50 and 70 kV) with 600, 1200, 3000 and 8000 rads 100 kV, 2 mA and 169 kV 6 mA) showed that the radiosensitivity of the chrysalis diminishes with advancing age. Detailed studies on the changes in body wall, brain, heart, hypodermis, muscles, fat cells, gonads, cell differentiation, etc. are reported. SS figures (NSA 6: 2605, 1952)

Inhibition of mitosis in embryos of the grasshopper Chorospora vibrata is at low doses of radiation is not related to an alteration in nucleic acid synthesis. As the 100% lethal dose (approximately 360 r) is approached, interference with nucleic acid synthesis becomes evident.


X-ray treatments of embryos or early larval stages of D. melanogaster will block the action of a specific suppressor gene and allow the normally present but suppressed mutant gene "emerges" to manifest itself in the adult stage. The facts that the blocking action of x-rays was not carried over to the next generation indicated that the suppressor gene had not mutated, but that its product had been inactivated.


X-ray treatments of embryos of the suppressor-empt stock block the action of a specific suppressor gene (E) and allow the suppressed mutant gene empt (e) to manifest itself in the adult stage. This stock also shows a high incidence of melanotic tumors (61.7%) induced by x-rays. When embryos were irradiated with 1000 r units at 20.4 hr in concentrations of 6% O2, 15% O2, 20% O2, and pure oxygen, there was, with increasing oxygen concentration, an increased inhibition of the action of the suppressor gene, with corresponding increase in the expression of empt (E). Increased mortality in the larval and pupal stages: (3) increased duration of development, with delayed pupation, and (4) increased incidence of tumors as well as increased numbers of tumors per affected larva. There is no observable effect when embryos are exposed to various O2 concentrations without being x-rayed. The incidence of tumors and the incidence of tumors both increase significantly and linearly from 0 to 20% O2, above which concentration there is only a small, though significant, further increase. The same treatment applied to an Oregon-R inbred strain gives similar results but at a much lower level. Mortality, extended and delayed development, and induction of melanosis all parallel the effects of x-rays on the suppression of empt at given oxygen tensions; but further work will be required to make clear the nature of the relation between the suppressor of empt and the parallel effects. (Abstract summary)


Physiological effects of various doses of x-irradiation on day-old male and female imagines were studied after repeated pair matings. Twenty-six different criteria for the physiological effects are discussed. (USA 61951-1953)


2130 Drosophila adults were given single or multiple doses of x-rays. Treatment doses range up to 6250 r. The flies were distributed in 5 factorial experiments. Twenty-six different criteria describe the physiological effects. Consideration is given to those factors which measure irradiation damage to the fly's life span and to the life of the progeny. Total eggs laid throughout the female's life presents a very complete measure of the functioning of the whole organism. Between 0 to 2500 r there was a 40% random variation in egg laid. This seeming threshold indicates the female's physiological functions are not seriously altered. Irradiation doses of 2500 r or more show a linear decline in eggs laid as dosage increases; at 10 000 r productivity was not 0, at 20 000 r less than 0.1%. Total days the female laid eggs measures the resistance to complete interfusion with functioning of reproductive system as distinct from rates of cell division. A threshold of little or no effect appeared between 0 and 3500 r. Days of egg laying were reduced linearly from 9 to 50% at 10 000 r. The capacity to lay eggs was reduced less than the eggs metabolized and laid. Life span of the females showed no reduction with exposure up to 1 500 r. Flies receiving 62 500 r lived about 40% as long as those without any treatment. Observations show that quantitatively the sex behave in similar manner when exposed to irradiation. (From abstr.)

1311 Gray, L. H. *PRIMARY STRESS OF ENDURANCE.* p. 265-70 (Dis. p. 370-4) Wolkenhorne, G. S. W., Ed. Metabolic pathways in the transfer is considered in connection with swimming and sleep. The relation between swimming and sensation is considered.


1313 Grasch, D. S. *THE ROLE OF HORMONASAL A GB. J. End.

1314 L'Hattier, M. P., Pau, J. LITÉ AU CO2 CHEZ LA E. La marche de l'insensibilité est de 28 ions. (Text)


1316 Kaplan, W. D., Hochman, M. *MELANOGASTER Gene* A study by means of two of different life stages of x-irradiation. Strain, method occurring in high consent glutamine, and prolins, lypins, asparatic acid, cyste amount of a substance to exist between males and apparently intermediate; substance will be present. (Abstract of paper presented 34-35 Aug. 1937)

1317 Karpov, A. E. *A COMPARATIVE STUDY OF POLYMERS.* In U.S.S.R. A comparative study of the atomic and nuclear incidence of induced pol
ACTION OF A SPECIFIC GENE IN PROKOPHILA. Proc. nat. Acad.

EFFECT OF X-RAY RADIATION ON THE NUCLEUS, and female imagos were studied.

PATTERNS OF FREE AMINO ACIDS IN PROKOPHILA. Genetica 42 (1967) 393.

A study by means of two-dimensional paper chromatography has been made of the free amino acid patterns of different life stages of wild type and several mutant strains of P. melanogaster before and after X-irradiation. Strains, male and female, and different life stages patterns have been compared. Amino acids occurring in high concentration are alanine, phosphatidic acid, glycine, histidine, arginine, asparagine, tyrosine, aromatic acid, cystine, valine, valine, serine, and glycine have been found. A difference in the amount of a substance tentatively identified by chromatographic techniques as methionine has been found to exist between males and females. The level of this substance is higher in males than in females and is apparent in 20% of 20X males. Data on the identification and quantitative determination of this substance will be presented.


A comparative study was undertaken of the influence of soft and hard X-rays (dose 5000 r) on the activity of the larval nuclear polyhedral virus in the silkworm (Bombyx mori). In these experiments two main types of larvae were used: type I and type II. The incidence of induced polyhedrosis depends on the kind of irradiation, as well as on the bienital properties.
and stages of development. In caterpillars, soft x-rays induced polyhedrosis approximately twice as frequently as hard rays. Irradiation of pupae caused no activation of the latent virus. (auth.) (NSA 15: 10570, 1061.)

1318 King, R. C. DOSE RECEIVED BY THERMAL NEUTRON TREATED DROSOPHILA MELANOGASTER.

Data on the chemical composition and capsule capture reactions of Drosophila tissue are presented from which it was concluded that the biological effects of thermal neutrons in adult Drosophila result from ionizing radiation activated by processes resulting from temperature capture reactions. (NSA 8: 838-7, 1954)

1319 King, R. C., Wilson, L. P. STUDIES OF THE RADIATION SYNDROME IN DROSOPHILA MELANOGASTER.
Radiation Res. 2 (1955) 54-55.

Effects of single exposures to massive radiation doses on mortality, oxygen consumption, growth, feeding behavior and certain aspects of phosphorus metabolism are described. Irradiation with approximately 60,000 r (both fast and fast adult D. melanogaster within 1 d and is lethal to 60% of the unirradiated flies within 2 weeks. Male die sooner than females, but show little or no modification of turnover and maintain their weights at control values. In contrast, the rate of growth of irradiated females is slowed down, but the flies eventually reach weights in excess of controls. Irradiated males have fast and slow phases of P turnover with lengthened half-times. The phase systems of fast and slow half-time are affected by different degrees by irradiation. However, irradiation does not affect the amount of P lost by each phase or the total P content of either sex of flies. The biological half-time for P is 9.9 d for normal flies, 2.0 d for irradiated females and 1.8 d for normal or irradiated males. Irradiation does not have an immediate effect on the efficiency of P extraction from yeast by the gut. It does have an immediate depressant effect on food intake and a depressing effect 6 d after treatment on the oxygen consumption of the flies. (See also research report EN1-1976, Brookhaven National Lab., Upton, N. Y., 1954. 24 p)

1320 Moreau-Rangel, M. EFFET DES RAYONS X SUR L’INTESTIN MUYEN DE ATLANTA FUSCA BR.

Nous avons étudié l’apparition des radiations de la muscosa du intestin chez Blatta fusea Br. exposées à la dose de 20,000 r. Les cellules les plus radio-sensibles sont celles de régénération, au moment de leur différenciation en éléments sécréteurs. L’irradiation n’a pas de séquence des cellules épithéliales. (auth.)


X-radiation could be shown to produce degradation and inhibition of nucleic acids synthesis in grasshopper eggs. Degradation was a delayed effect, and appeared to be a result of metabolic dysfunction rather than direct depolymerization. The irradiated cell was unable to replace the nucleic acids as they broke down. The results of phosphorus content analysis are tabulated. Inhibition of nucleic acids synthesis was most marked in the post-diapause eggs, whereas both the cytoplasmic and the nucleus of diapause eggs were sensitive to irradiation, the nuclei appeared to be more susceptible than the cytoplasm in post-diapause eggs.

(A detailed report was published in 1952. ASCC-1828, Massachusets Inst. of Technol., Cambridge and UAC-605, Argonne National Lab., Lemont, Ill.)


When diapause eggs of Melanopus differentialis are x-irradiated (200 KV, 15 mA) with doses ranging between 50,000 r and 250,000 r the dehydrogenase activity in the eggs is decreased immediately after the exposure. The enzyme activity increases with time so that the highest activity is obtained approximately 6 d after exposure. Oxidase activity after irradiation varies in the following sequence: 25,000 r > 50,000 r > 100,000 r > 200,000 r. The enzyme is inhibited by cyanide, carbon monoxide, and heat. Its activity is not affected by ascorbic, phenylhydrazine, or dicarbonylcarbamate. The oxidase is specific for hydric dilution. It does not oxidize choline or other oxidizable non-oxidizable as long as 100. The increase in hydrous oxygen repress radiation or to ox is 0.05.

1324 Thalmann, T. N., Adamson, D. M. BY X-RADIATION.

An abstract of this paper was published in ASCC-1828, Massachusets Inst. of Technol., Cambridge and UAC-605, Argonne National Lab., Lemont, Ill.

1325 Thalmann, T. N., Garrow, D. M. EFFECT OF X-RADIATION. Low dosage of x-radiation of grasshopper embryos by inhibition. By the use of x-radiation is demonstrated that the chromosomes may be damaged associated with the x-radiation procedure is given. The free P2O5 containing 2,000 µ, 2.5 µ, 24 µ, those used to 200 µ µ for periods from 1 to 6 months from vessels containing the culture

(An abstract was also published in ASCC-1828, Massachusets Inst. of Technol., Cambridge and UAC-605, Argonne National Lab., Lemont, Ill.)

1326 Thalmann, T. N., Passow, D. METABOLIC RATE ON THE EMBRYO. The extent of x-ray injury and physiological examination organization was able to determine the x-ray dose was required output under these conditions is calculated susceptibility to x-rays.

1327 Thalmann, T. N., Dworkin, D. M. FED. Proc. 22 (1943) 160.

Grasshopper embryos were exposed to 25,000 r in air and then to 5 r after irradiation for a period of 5 r after exposure was not more than 5 r after exposure. The time of irradiation is factor in increased radiation efficiency as previously reported with metabolism following a linear or a change of the time of injury produced.

340
plinidene approximately twice as frequently.

OSPHILA MELANOGASTER

Neoplastic tissue is presented from an adult Osphilia result from irradiation.

(1941) 1010

DIE IN OSAPHILA MELANOGASTER

Consumption, growth, breeding and irradiation with approximately 10% of the adult flies within 24 hours after irradiation and maintenance their females are timed down. But the flies die fast and slow phases of P turnover time are affected to different degrees by each phase to the total P content in females. 2.4 for irradiated flies have an immediate effect on the fat content and fat content in the flies.

N. Y. 1954, 249)

OSPHILA MELANOGASTER

On the basis of Blaina fascia for Blaina fossa X.

HOMOLOGIES I. MELANOGASTER

Nucleic acid synthesis in grasshopper eggs metabolic dysfunction rather than the nucleic acid as they broke down. The synthesis of nucleic acid synthesis was at the system of grasshopper embryos were in the testis of post-diapause

larvae inst. of Technol. Cambridge

NUCLEAR ACID SYTHESIS IN M. MELANOGASTER EGG

(192) 1954. 189-203

MELANOGASTER DIFFERENTIALIS EGGS

15.0 mA) with doses ranging from 15.0 mA to 100mA. The highest activity is obtained as the following sequence: lighted by cyanide, carbon monoxide or diethylthiocarbamate. The oxidase is specific for hydroperoxides and, in addition, it appears to have some effect on p-phenylendiamine-dinitrate. It does not oxidize the -SH group in glutathione or cysteine. Absorptive or transaminase-hydroxylase is also oxidized by the enzyme. The microsomal test reveals that the native -SH groups are not oxidized as long as 186 h after x-irradiation. However, by 18 d practically all -SH groups are absent.

The increase in hydroperoxide oxidase may be due either to the abolition of check mechanisms that normally repress oxidation or to an increase in the oxidase itself resulting from the breakdown of synegens in the flavin.


An abstract of this paper was published in Annu. Rec. 102 (1955) 516, abstr. 16.


Low doses of x-irradiation produced extensive damage in the embryonic cells of grasshoppers. The respiration of grasshopper embryos was increased during irradiation. Irradiation was immediately afterwards followed by inhibition. By the use of Fleming's triple stain it was shown that x-irradiation caused pyknotic chromatin to remain as if it were in the metaphase condition. This is evidence that injury sustained by the chromosomes may be direct and indirect. x-irradiation caused the appearance of some amorphous material associated with the chromosomes. The nature of this material is at present being investigated. Some of experimental procedures were given. The sources of x-irradiation were 59 and 60. The embryos were treated with carrier-free 59 containing 2.33 mc per 1 cm calculated to give 3.1 r/h for exposure to the source for 2.5-24 h. Those used for respiration studies were exposed to 59 and 60 solutions containing 2.25 mc to 9.20 mc for periods from 1-8 h. Equivalent amounts of phosphate or strontium chloride were placed in the vessels containing the controls.


The extent of x-ray injury in developing grasshopper embryos was determined by cytological, morphological, and physiological examination. At an optimum dose of x-irradiation the capacity of the cells to maintain organization was abolished, and they underwent regression to size. Under anaerobic conditions ten times the x-ray dose was required to elicit the same degree of damage observed aerobically, while the caloric output under aerobic conditions was about 500 times that measured anaerobically. The sequence of biological susceptibility to x-irradiation is: tissue differentiation > cell division > anabolism > catabolism.


Grasshopper embryos lend themselves to experimentation because of their ability to remain in a state of almost completely suspended animation for 48 h or longer. Grasshopper eggs in diapause were irradiated at 33,000 r in air and then in either 1 x 10^-2 T/M Co, 1 x 10^-6 T/M Co, or mixtures of CO and N2 or 96% N2, 5% CO from 5 min after irradiation for 24 h. In each case negative growth, which occurs in air 16 h after this irradiation, was arrested 20 to 50%. Statistical analysis indicates that this trend is highly significant. If embryos were irradiated in CO, KCl, or 4 atmosphere of O2 and then placed in air, the latter 2 resulted in greater regeneration while CO afforded almost complete protection. The ability of O2 and KCl to form radicals at the time of irradiation is well known, and suggests that radical formation or the time of exposure is a factor in increased radiation susceptibility. On the other hand, metabolic studies at the time of irradiation as previously reported with CO/CO2 (95% and 5%) respectively and with CO as well as lowering metabolism following irradiation with KCl, CO and N2/CO2 and CO/N2 mixtures, suggests that the metabolic rate at the time of irradiation, or immediately after irradiation is directly proportional to the degree of damage produced.

The O2 consumption of Cheethousura eggs measured at 38°C in 02. averaged 78. 8 ± 3. 3 mmHg O2/100 eggs/hr increased 22% during a 6-hr period of respiratory determination. When measured at 38°C in air, the rate of O2 consumption did not change during a 4-hr period. Winter embryos freed of yolk and placed in isotonic medium respired at a significantly lower rate than did spring and summer embryos treated in the same manner. The addition of glucose to the suspending medium had no effect on the respiration of embryos. Comparable rates were obtained with measurements of 60 embryos in water and of polyhydral embryos in Krupka rearmament. X-ray doses of 10,000 r and above significantly reduced the O2 consumption of 14-day Cheethousura eggs in the first hour after treatment. Doses of 3000 r and above significantly reduced the respiration of embryos in the hour following irradiation. The reduction in respiration increased with larger doses of x-rays. (auth. summary)


A correspondence has been shown to exist between the production of an attractant substance and the mating period of Periplaneta americana. The attractant is produced principally by virgin females and, sporadically, by mated females, and is conducive to mating; however, mating depresses the production of attractant. Production of attractant normally decreases with age, and generally production increases. Mating induces an increase in sexual production, especially among younger cockroaches. Cathode-ray irradiation (from a 2-MeV Van de Graaff electron accelerator) damages sexual and attractant production. With sexual production totally inhibited by irradiation, the females recovered their capacity to produce attractant and exceeded the normal yield. A relationship is indicated between attractant production and the processes which regulate oviposition. (auth.)


The Mediterranean fruit moth, E. ribesella, belongs to the group of larvae (heterodermatina) in which a continuous succession of generations occurs as long as conditions are favourable. The course of several experiments by a larval irradiation with doses ranging from 40,000 to 160,000 r. Following a short period of inactivity they moved about normally and were readily caught by the parasite wasp Heliococcus. Those not exposed to the parasite continued to crawl, and some pupated. All lived for at least a few days, and some (41/175 or 23. 1%) were still alive 30 or 40 d after exposure. Control larvae pupated 3 d after time of exposure of treated larvae. The behaviour of the irradiated larvae resembles that of diapause larvae in forms (heterodermatina) which show a prolonged arrest of growth. In this stage, whether the x-ray-induced inhibition is due to an interference with secretory processes controlling pupation or to injury to cells of the larval imaginal stage vital to pupal formation is not known. Two irradiated in the prepupal stage pupated but failed to eclose. (Abstract of paper presented at the 4th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, 27-30 Dec. 1953.)


Additional investigations on intermittent x-irradiation of Drosophila eggs and pupae are reported. Although the previously observed ultrafractionation effect was reproduced in the pupae, no effect was observed in 4. 5 ± 0. 25-h-old eggs for single irradiation times between 1 hr and 4X 10^-5. If such an effect exists for egg it must appear at shorter irradiation times than 4X 10^-5. Significance of the ultrafractionation effect for explaining the biological action of betatron radiation is discussed. (NASA T. 766, 1959)

Younger, A. P. THE EFFECT OF X-RAYS ON SPIRIT ACTIVITY IN DROSOPHILA. (abstr.) Genetics 44 (1959) 548-6.

A study was made of the post-copulatory migration of spermatids from the region of the ventral receptacle of the female. The fullness of the excised receptacle was measured and used as a measure of the relative activity of control and irradiated spermatids. Immediately following doses of 2500 r a significant reduction
in the degree of successful insemination was observed but the males showed recovery if held for 24 h before mating. Recovery may be complete at doses below 10,000 r. This finding has a direct bearing on dominant lethal studies. Kaplan (1950) has shown that unirradiated eggs may cause significant to the dominant lethality rate as measured by hatching failures. Irradiation may contribute to fertilization failure by reducing the activity of individual sperm, and by lowering the number of sperm stored by the laying female.

Effects on feeding activity

* Clark and Kelly 1930 - [669]


Five successive generations of Tribolium melanogaster were grown on a brewer's yeast medium irradiated with 1 million r of γ-rays from a Ca60 source. The irradiation dose selected lies between the pasteurizing dose range and the so-called "sterilizing" dose for most micro-organisms. Studies of longevity, fecundity, egg hatchability and body weights of several thousand flies disclosed no significant detrimental changes in the characteristics studied when evaluated at the 95% significance level with comparison with the unirradiated medium. No toxic substances are produced in an aqueous yeast suspension by the application of $10^6$ r of γ-irradiation, the concentrations are such that no deleterious effects are grossly evident in flies grown solely on irradiated medium for several generations.

(The study was also published in UC-486, Rochester, N. Y. Univ., Atomic Energy Project, 1957, 89 p)


In experiments to determine whether grain irradiated with cathode rays in a Van de Graaff accelerator (cf. RAD-A 44/279) differed from untreated grain as a food for Tribolium confusum (O. F. M. Calandra) (Tribolium granarium and Tribolium castaneum) (O. F. M. Calandra, wheat irradiated at $10^6$, $10^5$ or $10^4$ r had no apparent deleterious effect on the reproduction potential of insects reared on it; when differences did exist, an increase in reproduction was evident. (RAD-A 48/1229, 1959)

1341 Родионова, Л.З. ИЗМЕНЕНИЕ АКТИВНОСТИ ПИТАЯЩИХ ЖУКОВ АМБИГУТОСА, ОБЩЕНИЯ Х-ЯЩУЧИЯ, ТУРМЫ БЕЕЛО-ГУСЕВЫЕ И ПРОДУКТОВ ИХ ПЕРЕРОБКИ. Насекомь 55 (1960) 56-61.

Жуков (X) обрабатывали в рентгеновской установке УРП-3 (200 кВ, фокус 5,5 мм) до доз 10 000 р. м. мощность доз 950 р в 1 мм. В 1-й серии опытов определяли через 10, 20 и 30 суток число вредных, поврежденных и контрольных жуков. За вычетом 5 суток убывали живых и съеденных жуков и на одну зону жуков. В 2-й серии в те же сроки определялись числа пчел, съеденных в счет и контрольные, причем отношение отнесенного к наточенной жужки. Через 10 и 20 суток жуков в обработанных зонами, чтобы не создать вреды и пчелам, отстреливали в старом зоне.

Велика потребительность жуков из зон X того же вреда обрабатывал. Средние числа жуков, поврежденных обработками жуков, и убывали они значительно быстрее, чем без обработки X. Во 2-й серии в такие сроки через 10, 20 и 30 суток, съеденной одним обработанным жуков, и убивали жуков, попадающих в контрольные жуков на массах (3,45 - 4,05 р). На эфиров, съеденных в 1-й и 2-й дни обработанных жуков, почти в два раза меньше, чем контрольных жуков. По ходу зон X-дозы это не все выражается, так как в первый 20 суток ~ 90% обработки жуков снижается, а в несколько рекомендуется X-дозы, так же как и контрольные.


Grain weevils were irradiated at 10,000 r of X-rays at a dose rate of 950 r/min. The amount of damaged kernels was checked at 10, 20 and 30 d. At 5-d intervals dead weevils were removed and a similar number of controls. By 30 d, the damage done by irradiated weevils was 80% less than by the controls.

Glass and Paule 1966

1342 Rogers, W. L., Hildeby TRIBOLIUM GNP. Not irradiated Tribolium as or in the presence of C. agricola. difference Tribolium fed on the c. agricola material was not from radiation. Tribolium capable of damaging c. agricola which product

1343 Rogers, W. L., Hildeby CASTANUM GENUS Adults that had been a click. Longevity radiation. After exposure 13 and 7th days, and nutritional state of the At least two dose effects by T. castaneum.

1344 Falbany, O. C., Falbany INHIBITORS IN ENZYME MUTAGENIC AND Work on the alkylation of the mutagenic process of the alkylation current (b) the ratio of the strain along the X-chromosomes to induce nearly 500 ° different from those in are not associated with they are not alkylic to morphogenetic loci, r. probably on the other treated chromosomes (a. alamid), which mutate. Among the sex-linked fixed proportion show deficiencies. (CA 59)

Gheleliritsch, S., SHU O X CHEM FERMIPLA

La réponse à l’irradiation constitutionnelles X et peut être attribuée à la lésion d’irradiation.
The weight of wheat consumed by irradiated weevils at the end of 10 and 30 d was half that of the controls, but by 30 d it was about the same, since 90% of the irradiated weevils died during the first 20 d and the resistant ones fed with the same intensity as the controls. (From Reference Zentralblatt für Biologie 1: 788 (1959))


Irradiated Tribolium adults lived longer in a culture medium of wheat flour than in the absence of a medium or in the presence of Cadmium or powdered cellulose. When no culture medium was provided, there was no appreciable difference in the median lethal times between irradiated and unirradiated individuals. Living Tribolium fed on the carcasses of beetles which had died previously. The use of either flour or non-nutritive materials eliminated this response. The presence of a thin layer of medium provided no protection from radiation. Tribolium larvae were tested similarly. These tests indicate that Tribolium adults are capable of damaging or infesting substance items after the beetles have been exposed to doses of beta radiation which produce delayed lethal effects.


Adolescents that had been exposed to selected doses of high-speed electrons were subsequently offered various diets. Longevity studies and radiobiologic tracer studies showed that they fed to some degree after irradiation. After exposure to 17,400 rad, or more, feeding ceased for at least 2 d, then resumed between the 5th and 7th days, and the amount of feeding depended on the dose of radiation previously applied. The nutritional state of the beetles after exposure to certain doses of radiation affected their life expectancy. At least two dose-dependent modes of mental response to irradiation with high-energy electrons were exhibited by C. castaneum, and starvation was not a primary cause of death in irradiated individuals. (aut.)

I-C-T TUMOUR FORMATION


Work on the alkylating compounds, described here, gives the first decisive evidence for the nonreversibility of the mutation process. This evidence is based on three major differences in the mutagenic mode of action of the alkylating compounds and x-radiation, as regards: (a) the morphogenesis loci (which are affected), (b) the ratio of the recessive visible/lethal induced, and (c) the distribution of the loci of genetic effect along the X-chromosome. By the use of selected representatives of the alkylating compounds it was possible to induce nearly 200 "case" sex-linked recessive visible, resulting in phenotypic expression completely different from those induced by other mutagens, especially radiation. The great majority of these mutations are not associated with chromosome aberrations detectable in the salivary-gland chromosomes and apparently they are not allelic to any of the known x-ray visible.

The selectivity here demonstrable is for certain morphogenesis loci, rather than for certain chromosome segments, a selectivity of a very fine nature, probably on the molecular level. The ratio of sex-linked recessive visible/lethals in the same sample of treated chromosomes is exceptionally high for a particular amino mutant in N-N(2)-diethyl-N- N(2)-diethylaminoethyl-phenylnitrosamine, which mutates 2-3 times as many morphogenesis loci as x-rays or any other alkylating compound. Among the sex-linked recessive lethals induced by various doses of tri(ethylamino) triazine there is a fixed proportion showing cytologically detectable chromosome aberrations, i.e., major rearrangements and deficiencies. (GA 50: 5595, 1960)


La réponse à l'irradiation par la formation des tumors mécaniques dépend, chez la drosophile, de la constitution héritée des individus irradiés. Cependant, la sensibilité à l'action tumorigène des rayons X ne peut être attribuée exclusivement à la présence dans le génotype du génome tumoral responsable de la production héritée de la tumorigènesse spontanée. (aut.)

Glas and Plance 1985 — [1185]

D. melanogaster embryos of the suppressor-erupt stock, treated with x-rays showed a high incidence of melanotic tumors in the larval cuticle and many of erupt eyes in adults. These effects depended on the concentration of oxygen in the atmosphere at irradiation. Effects of exposure to O₂ and exposure to H₂O₂, or both, were also tested. The experiments indicated that the effect of the x-rays in producing both melanotic tumors and erupt eyes might result from the production of oxygen by O₂ or parent oxidizing agents with an action analogous to that of peroxide. The effects of intermediates in tyrosin metabolism in the incidence of tumors and erupt eyes were also studied.


A stock of Drosophila melanogaster contained a suppressor gene Cg inhibiting the manifestation of erupt embryos (a mutant that produces an abnormal growth of tissue which erupts through the eyes). When the embryos were x-rayed, they were blocked and melanotic tumors formed. On increasing oxygen concentrations from 0 to 20% at the time of irradiation, the incidence of tumors and erupt increased linearly. An increase of oxygen concentration to 100% there was a small further increase in tumors and erupt. Mortality and duration of development also increased with increasing oxygen content at the time of x-ray treatment. The same differential responses to x-rays in varying oxygen concentrations (but with all responses showing a much lower incidence) also occurred in another tested stock. The incidence of melanotic tumors in both stocks was slightly increased by exposure of the embryos for 10 min to pure oxygen without x-rays, and was further increased by similar exposure to pure nitrogen. This was not affected by oxygen in the absence of x-rays. (Ca 47, 855, 1958)


The results obtained when embryos are exposed to solutions of hydrogen peroxide or pure oxygen without irradiation, together with those obtained when embryos are irradiated in different concentrations of oxygen, suggest that x-rays may produce both melanotic tumours and erupt eyes by the production from oxygen of certain potent oxidizing agents analogous to and including hydrogen peroxide. (From J. Nature 1958, 176)


Seven-day prediapause grasshopper embryos Melanoplus differentialis, Thomas were irradiated with 200 r of X-irradiation (200 kV, 15 mA) at dose rates of 1 r per min and 500 r per min. The embryos were dissected out of the eggs and observed 21 days prediapause or 24 days postdiapause. Those embryos that received 200 r per min had brains at a ratio of 6 to 1 in comparison to those that received the same total dose at 1 r per min. Other embryos receiving 500 r per min were administered half of the dose in the beginning and the other half at the end of 248 min in order to compensate for the 256 min interval of irradiation at 1 r per min. Splitting the dose did not make any significant difference upon the incidence of teratogenesis in comparison to those that received 200 r in 24 min. This is indicative that there is an intrinsically mechanism for recovery from irradiation.
INDUCING MELANOCYTIC TUMORS IN DROSOPHILA MELANOGASTER. p. 1187-9 in "1957 Gif. Suppl. to Carabologia."

Some showed a high incidence of tumors. These tumors depend on exposure to O₂ without irradiation as the zygote of the x-rays in induction by oxygen of H₂O₂ or the effects of intermediates in the studied.

RADIATION-INDUCED OVARIAN

A dose of 4000 r of Co⁶⁰-γ-rays of tumour formation is postulated.

AND THE INDUCTION BY


(Early the manifestations of oocytes in the eye). When the embryos oxygen concentrations from 0 to 100% linearly, on further increase burn and emit. Mortality and the time of x-ray treatment.

(p) but with all responses showing a variety of melanotic tumours in both oxygen without x-rays, and was highest in the absence of x-rays, determining the effectiveness of induced melanogaster" by the same

ACTION OF A SPECIFIC GENE


of x-rays in embryos to pure oxygen without other different concentrations of oxygen, the production from oxygen of side.

(From another summary)

LANOPLUS DIFFERENTIALS (Gen. et al.) Annu. Record 123, 3

Thomas were irradiated at 800 r per min. The embryos irradiation. The embryos that were the same total half of the dose in the for the 200 min interval of observation upon the incidence in them is indicative that there is an


I-D Combination or Comparison of Several Treatments

(Other Radiations, Heat, Chemicals, etc.)


Some experimental studies on the effect of pre- and post-irradiation treatments of cells in damage resulting from exposure to ionizing radiation are reviewed. The influence of O₂ tension on damage induced by nitrogen radiation follows a strikingly similar pattern in the case of different biologic responses in plant and insect cells, whereas its influence on x-ray and neutron damage is relatively slight.


This is a general paper, giving an overall view of the problem. Mention is made of the variety of cells in which damage from ionizing radiation was enhanced when it occurred in the presence of O₂. The approach of the physiologist to the problem of the O₂ effect is outlined, the author himself proposing a biochemical approach. Experimental data including some results for grasshopper eggs are cited in support of his argument.


Through the use of x-ray dosage fractionation methods, it became possible for the first time to demonstrate in drosophilas in particular effects of oxygen concentration on induced gross chromosomal rearrangements and to test separately the efficacy of different oxygen concentrations applied before, during, or after irradiation. O₂ present at the time of irradiation, results in a significantly greater frequency of half-translocations than produced in air. Anemia (p₉₈) at the time of irradiation results in a drastic reduction in the frequency of half-translocations as compared with air. Oxygen between irradiations is not as effective as air in reducing the half-translocation frequency. Anemia between the two x-ray fractions increases the half-translocation frequency. Although a part of this effect may be due to the presence of oxygen radicals it seems to be greater than can be expected simply on the basis of the passive role. Post-oxygen treatment had no detectable effect but post-nitrogen exposure significantly increased the rearrangement frequency. (auth.)

An abstract of an earlier paper "The effects on rearrangement frequency of different oxygen tensions during or between fractionated x-ray treatment of drosophilas oocytes" appeared in Genetics 43: 651, 1965.

Alexander and Stone 1956 - [1156]


Radiation treatment of post-metocytic cells of spermatogonia in D. vigilis resulted in differences in the number of translocations and dominant lethals. Qualitative as well as quantitative differences in radiobiological damage were found in mitotic and spermatogonial cells. Post-metocytic cells varied in sensitivity to x-rays, γ-rays, and fast neutrons. With these radiations, biological damage was considerably higher in spermatids than in mature sperm when O₂ was present during treatment. O₂ concentrations over 90%
did not increase the damage in sperm cells; however, in spermatids an atmosphere of pure O$_{2}$ continued to increase the biological damage over the values obtained for air. Lethal damage in intact and spermatogonial cells was influenced by increase in O$_{2}$ concentrations with x-rays and fast neutrons. Differences in the lethal damage induced in spermatids by x-rays in pure O$_{2}$ were obtained by varying the dosage of radiation. Mature sperm showed no difference in lethal damage, whether fast, slow, or fractional doses of x-rays were used in an atmosphere of N$_{2}$.

(Ref. 30: 2079(6a, 1958)

The effects of infra-red and ultraviolet light, and of x-rays and accelerated electrons are described on Tribolium confusum, T. spinigerum (L.), and Acanthoscelides obtectus (Say). The physical aspects of the work are discussed. (See also Talkhouse, R. S. 1953. M. S. thesis)

Males of the Oregon-R strain of D. melanogaster were subjected to x-radiation (3000, 3000 or 5000 r units, 250 kv potential, 15 mA) while in an atmosphere of either O$_{2}$ or N$_{2}$ at an approximate temperature of either 27 or 35°C. The number of X-chromosomes which bear recessive lethal mutations was determined by mating the treated males to the females of Muller-5 stocks using the technique outlined by Spencer and Stern (Genetics 33 (1948) 43-74). Depending upon the dosage, a 40-70 per cent reduction in the number of sex-linked lethal mutations is observed in the sperm from the flies irradiated in N$_{2}$ as compared to those treated in O$_{2}$. Indirect evidence also indicates that the induced frequency of dominant lethals is greatly reduced when the flies are x-rayed in N$_{2}$. A significantly greater number of mutations is induced in the flies treated in O$_{2}$ at the cold temperature than in those maintained in N$_{2}$ at the warm temperature. This "temperature effect" is not evident when the flies are irradiated in N$_{2}$ but indicating that this effect is related to the O$_{2}$ concentration in the sperm. The data are compatible with the differences in solubility of O$_{2}$ at the temperatures used. Control experiments were performed in which series of flies were subjected to each gas at two temperatures without irradiation. These experiments show no alteration of the spontaneous mutation rate.
(Anonymous paper presented at the 1949 meeting of the Genetics Society of America, New York City.
28-30 Dec. 1949)

A striking reduction has been found in the number of recessive sex-linked lethal mutations induced in D. melanogaster males when they are exposed to x-rays while in an atmosphere of low concentration.
Although an increased number of mutations were induced in flies irradiated in O$_{2}$ at 35°C over those treated in O$_{2}$ at 27°C, this increase was not due to the temperature per se but rather it was apparently causing a higher oxygen tension within the irradiated sperm at the lower temperature. Additional evidence also indicates that fewer dominant lethal mutations and chromosome aberrations are induced in flies maintained in a near O$_{2}$-free atmosphere during irradiation. (auth.)
(This work was also published as report ORNL-978, Oak Ridge National Lab., Tenn. 1959, 18 p)

Translocations were induced in Drosophila with x-rays by exposing to 2000 r of x-rays adult males maintained in various concentrations of oxygen during treatment. Less than 4 as many translocations are induced in the absence of O$_{2}$ (in N$_{2}$) as is the case when the males are irradiated in 100% O$_{2}$. Studies on the production of sex-linked recessive lethals in D. melanogaster indicate that about 1 as many lethals are induced by 4000 r of x-rays when the males are exposed in a N$_{2}$ environment as compared with pure O$_{2}$. For the induction of both translocations and recessive lethals, the shape of the curves relating the genetic effect to O$_{2}$ concentration is strikingly similar. At low O$_{2}$ concentrations, small changes in the O$_{2}$ tension cause a rapid rise in the amount of genetic effect produced until a concentration of about 1/2 is reached. At this point the curves break sharply and further increase in the amount of O$_{2}$ has little or no effect on the frequency with which translocations or recessive lethals are induced by a given dosage of x-radiation. (auth.)

The production of dominant and oxygen concentration lethals induced in sperm x-rays period after irradiation co period. Dominant lethals males irradiating males the first sperm batch but 1 case of dominant lethal I decrease in O$_{2}$ effect in I recovered in males treated over the two period. by chromosome breakage interpreted on the view that the broken ends form rather than those induced in air.

(Anonymous paper presented at the 1950 meeting of the Genetics Society of America, New York City.
28-30 Dec. 1949)

A study of the relation of mature sperm of D. melanogaster N$_{2}$ is reduced much less number of primary breaks 24 hr have elapsed b treatment. This effect is that O$_{2}$ concentration A low O$_{2}$ concentration results in more easily than to the differ

Baker, W. K., Halle, E. A RING CHROMOSOME. Drosophila melanogaster in an environment of either the sex ratio in the offspring ratio or the frequency of chromosome ends rather

Baker, W. K. THE CY. Symposia in Biology, 18 The effect of low O$_{2}$ con

Baldwin 1856 - 1884

Baldwin, W. F. Narrow Nature 17 (1887) 978-9

Results of experiments show the (4+4) mosquitos to 599-606 r of x-

The mechanism by which an organism such as a despite the striking and two agents are ad
The atmosphere of pure O₂ continued to damage in methic and sperm-male
fast neutrinos. Differences in the
varying the dosage of radiation,
or functional doses of x-rays were

ATOMIC PARTICLES ON CERTAIN
electrons are described as an
obscure (Ray). The physical

OF DROSOPHILA BY MEANS OF
Radiation (1990, 3000 or 5000 r units),
apparent temperature of either
radiations was determined by measuring the
by Spencer and Stenn (Genetics
in the number of sea-linked
compared to those treated in O₂,
induced in the flies treated in O₂
in the temperatures at the temperatures
exposed to each gas at the two
the spontaneous mutation rate.

A1 ON THE RATE OF X-RAY
Germ 21 (1935) 276-84.
mutational mutations induced in
lower concentration.
O₂ at 2°C over those treated
or it was apparently caused by a
additional evidence also in
induced in flies maintained

, Texas. 1969, 18 p)
AND RECESSIVE LETALS IN
(1956) 655-77.
1 of x-rays adult males main-
many transplantations are induced
10%. Studies on the product
as many lethals are induced
mixed with pure O₂. For this
relating the genetic effect
changes in the O₂ tension cause
about 11% is reached. At this
little or no effect on the fre-
dosage of x-radiation. (auth)

The production of dominant lethals in males of D. melanogaster was studied as a function of x-ray dosage and oxygen concentration (air, 95% O₂ and N₂). The experiments were designed so that the dominant lethals induced in sperm which were ejaculated in copulation with single females during the first 24-h period after irradiation could be separated from lethals induced in sperm used during the second 24-h period. Dominant lethals were determined from counts of hatched and unhatched eggs laid by these females. Irradiating males in N₂ effectively reduces, as compared to air, the dosage by a factor of 1.5 in the first sperm batch but by only 1.2 in the second batch. Thus the end result of O₂ action is less in the case of dominant lethals than that reported for recessive lethals and chromosome aberrations. The further decrease in O₂ effect in the second sperm batch is due solely to a reduction in number of dominant lethals recovered in males treated in air and 95% O₂. The number induced in N₂-treated flies remains constant over the two-day period. It is generally agreed that dominant lethals induced in sperm are caused mainly by chromosome breakage with the resulting formation of inviable rearrangements. These data can best be interpreted on the view that the number of breakage induced by x-rays in independent O₂ concentration but that the broken ends formed in N₂ are more likely to rejoin (either to reiterate or to form new arrangements) than those induced in air.

(Absent of paper presented at the 1956 meetings of the Genetics Society of America)

A study of the relation between x-ray dosage and O₂ concentration on the induction of dominant lethals in mature sperm of D. melanogaster shows that the frequency of dominant lethals induced upon irradiation in N₂ is reduced much less than would be expected on the hypothesis that O₂ concentration is affecting the number of primary breaks induced. Fewer dominant lethals are recovered in sperm exposed to air when at least 24 h have elapsed between treatment and incubation than when incubation very shortly follows treatment. This effect is not observed in N₂-treated sperm. These data can be interpreted on the basis that the O₂ concentration affects the amount of restitution of chromosome breaks taking place in the sperm. A low O₂ concentration during irradiation makes restitution more likely, and the broken ends apparently reiterate more quickly. Therefore, the data lend support to the differential restitution hypothesis of O₂ action rather than to the differential breakage hypothesis. (auth)

Drosophila melanogaster males having the X-chromosome and a marked Y were irradiated with x-rays while in an environment of either air or N₂. Induced loss of the ring chromosome was measured by determining the sea ratio in the offspring. At low dosages, only a very small O₂ effect was observed on either the sea ratio or the frequency of X-O males. The data favour the hypothesis that O₂ acts on the rejoining of broken chromosome ends rather than on the initial number of breaks induced by the radiation. (8439; 9429, 1959)

The effect of low O₂ concentrations on the mutagenic activity of x-radiation is discussed. 24 references.

Baldwin 1956 - [1944]

Results of experiments carried out on Dendroica fulviventris (Zett.) are presented in graphical form, and show the (24-h) mortality in the chalcid when held at different temperatures before, during and after exposure to 2000 r of x-rays. A table also gives the effect of the sequence of exposure to heat and x-rays. The mechanism by which heat so drastically influences the killing when applied after x-rays is not clear. In an organism such as an insect where large x-ray doses are tolerated, x-rays and heat are not equivalent despite the striking similarities in lethal effects, since the end results depend on the sequence in which the two agents are administered.

319

In previous studies, a marked similarity was found between killing by high temperatures and killing by high doses of x-rays in adults of Daphniomis (Baldwin, 1955). In the present experiments, the lethal effects of x-rays were drastically modified by temperatures which are normally non-lethal (10° to 30°C), the effect being observed when the temperatures were applied during or after the irradiation, but not when they were applied before the x-rays (e.g., an increase from 5% to 10% kills). When sub-lethal x-ray doses were used, subsequent exposure to heat which would not normally give any mortality produced a high kill within 24 h. (In the reverse order, heat followed by x-rays, negligible killing occurred.) If a period of time was allowed to elapse between the x-ray and the heat exposure, significant recovery occurred during the intervening period, when giving 100% mortality when the x-ray was followed immediately by heating resulted in progressively lower kills with longer delays between the two agents, mortality amounting to only 35% with a delay of 24 h. Apparently, some system (e.g., an enzyme system) becomes reversibly sensitized towards heat as a result of the x-ray exposure.

Baldwin, W. F. RECOVERY FROM X-RAY-INDUCED SENSITIVITY TO HEAT IN AN INSECT. Radiation Res. 6 (1956) 17-21.

An investigation is described into the recovery of the hypersensitive parasite, Daphniomis fisheri (Zett.), from x-ray-induced sensitivity to heat, and the effects of metabolic activity on the rate of this recovery. Recovery was tested at various temperatures, also, the influence of food, oxygen and carbon monoxide on the speed of recovery. The number of insects used for these tests was in excess of 200 for each point on the graph given. A sublethal dose of 60,000 r produces a linear sensitivity to heat shock. Thus, if the irradiation is followed immediately by exposure to 45°C for 60 rain, which is sublethal for unirradiated insects, most of the irradiated insects will die within 24 h. Over a period of time after x-irradiation this sensitivity to heat gradually declines. The rapidity of the decline varies widely with temperature, being about ten times as fast at 22°C as at 12°C. Carbon monoxide inhibits the recovery while present, but recovery resumes when it is removed. Food and pure O2 have little or no effect. In these experiments, heat exposure can be thought of as a means of detecting an otherwise "hidden" effect of the x-irradiation. The recovery from this "hidden" damage might be associated with (1) a loss of poisons resulting from the x-irradiation or (2) a repair or replacement of damaged molecules.


Fused 4th instar Rhodius prolixus nymphs were held in either N2 or air and irradiated, then fed, and returned to a normal incubator. The delay in molting in N2 was barely perceptible but was quite large for an equal dose in air. Burns did not develop in N2 for doses below 120 kr, but were invariably present for 60 kr in air. (NSA 13: 11580, 1955)


The latest effects of x-irradiation in delaying mitosis are readily observable in the epidermis of the insect Rhodius owing to the degree of synchrony of division in these cells following a blood meal. At the dose employed in these studies (~ 25,000 r), mitosis did not proceed beyond metaphase when the insects were exposed in air; after irradiation at the same dose in N2, a prolonged division was completed with the greater part of the inhibition occurring during metaphase. (auth.)


It was shown that breakage, measured as ring loss, is less frequent in x-rayed oocytes than in x-rayed sperm. This finding and that of Glass (1955) that x-rayed oocytes in coccytes are more frequent than those induced in males, are explained by means of an hypothesis. A further study is described of the ability of ring loss in males and in females, in both air and nitrogen, induced by soft x-rays and by hard y-rays. With x-rays, there was a small but quite significant effect of O2 on ring loss in X4N, Y males, and a larger effect on ring loss in X4N, Y females. With y-rays, however, no demonstrable effect of O2 on the frequency of ring loss in either sex was found. (from auth. summary)
HEAT IN AN INSECT. Radiation

Ernst, 1955 - [1177]


Habrobacoton, when exposed to O2 during the early pupal stage of development, are deleteriously affected. A high proportion of pupae do not complete development and many of the adults that emerge exhibit wing and abdominal abnormalities. The pupal females pupae are more sensitive to O2 than are comparable male pupae. Habrobacoton treated at larval and pupal stages of development are not deleteriously affected. Male pupae and diploid female pupae were X-rayed in the presence of air, O2, or N2. The deleterious effects of X-radiation were compared using adult emissions as the criterion of viability. The percentage of adult emissions for these groups shows that pupae irradiated in the presence of nitrogen are over twice as resistant as pupae treated in the presence of air or oxygen. Pupae irradiated in the presence of air are slightly more resistant than those treated in the presence of O2. The increase in radioresistance with N2 is proportional for the more radioresistant diploid males and the less radioresistant diploid females. Male pupae during the pupal stage are more sensitive to X-rays, but less sensitive to O2 poisoning than comparable females.


Chapin, A. M., Besser, W. C., Jr. USE OF HAPLOID AND DIPLOID EMBRYOS OF HABROBACON IN THE STUDY OF CELL POISONS. Science 121 (1955) 469-70.

The differential toxic effects of chemical agents were evaluated using the hatchability of eggs from mated and unmated Habrobacoton as the criteria. Data are tabulated on the response of both haploid and diploid embryos to X-radiation, methyl bis[3-chloroethyl]amine HCl, ethyl bis[3-chloroethyl]amine HCl, 2,3-dichloro-dicyclohexylamine HCl, and 2,3-dichloro-dicyclohexylamine HCl, sodium azide, and potassium cyanide. (ASA 9: 8977, 1958).


Habrobacoton during the larval-pupal development were exposed to X-rays in the presence of air, N2, CO2, and H2. The effects of development on adult embryos were observed. Organs irradiated in nitrogen were about three times as resistant as those irradiated in air at the same stage of development tested. Habrobacoton during the larva-in-pupa stage were more radioresistant when irradiated in the presence of H2 than in the presence of air. Further, groups irradiated in N2 or in CO2 were more resistant to radiation damage than those treated with H2. Thus, the radiosensitivity was modified by the presence of H2. The authors conclude
that the data so far indicate no clear relation between Osub 2 poisoning and x-radiation damage in Halobacterium. (from auth. summary)

(An earlier report, BNIL, 1963, Brookhaven National Lab., Upton, N. Y., has appeared)

* Clarke 1956 - [1845]

1975 Clarke, A. M., Grisafe, V. J. SOME EFFECTS OF OXYGEN ON THE INSECTS, ANAGASTA KURHIELLA
AND TENEBRIO MOLITIVITY. TID-6002, Delaware, Univ., Newark and Oak Ridge National Lab., Tenn.,
1953, 28p.

The effects of Osub 2 at increased partial pressures upon the development and Osub 2 consumption of larvae and pupae of Anagasta kurhreilla and Tenubrio molitor were studied. Anagasta pupae exposed to 15 psi or more of Osub 2 are prevented from emerging as adults. For 15 psi of Osub 2, development of the pupae to the adult stage continues but most of these remain encapsulated within the pupal skin. Pupae exposed to 30 psi or more of Osub 2 may become paralyzed and show a marked and irreversible decrease in Osub 2 consumption. Most of the Tenubrio pupae exposed to 150 psi of Osub 2 show a marked and irreversible decrease in oxygen consumption and an inability to become pigmented. Parasites and ligament to pigment are correlated with, and probably a consequence of, decreased Osub 2 consumption. Most of the Tenubrio pupae exposed to 60 psi of Osub 2 became pigmented but did not develop to the adult stage and emerge. Both larvae and pupae are injured by Osub 2 and by x-rays. Larvae, however, are more resistant to radiation sensitive than pupae. The Osub 2 consumption of pupae is not decreased by exposure to 50,000 r. These differences indicate that different mechanisms of action are involved in injury by Osub 2 and by x-rays. (auth.) (NBA 74: 16250, 1960)

1977 Eddington, C. W. THE EFFECT OF 8, 9-DIAMINOTHYLMETHYLMETHACRYLIC ACETATE (8) ON THE INDUCTION OF DOMINANT AND SEX-LINKED RECESSIVE LETHAL IN DROSOPHILA MELANO-
GASTER. Amer. Nat. 93, 867 (1959) 571-4.

A comparison of the effects of injections of 8,9-diaminothymylmethacrylate (8) into (as a control) prior to x ray exposure (6000 r) indicates that 8 (an effective agent in preventing acute radiation lethality in mammals) enhances the genetic effect of radiation. This effect was demonstrated for both genetic effects studied. Furthermore it was shown that 8 alone did not behave as a mutagen. The difference in behavior of 8 on radiation induced physiological death in mammals and genetic lethality in Drosophila may exist in the nature of the biological mechanism, the inherent differences in the organisms, or in the somewhat greater radiation dose used in the Drosophila experiments. (auth.)

* Egli 1956 - [0150]

1978 Fahmy, O. G., Fahmy, M. J. CHEMICAL AND RADIATION MUTAGENESIS IN DROSOPHILA MELANO-

The mutagens used were all alkylating compounds: mustards, esters, imines and methylene. A similarity was observed in the distribution of the loci of action of different alkylating agents, which was also true for the cytologically detectable chromosome aberrations among the sex-linked recessive lethals. Both genetic and cytopathological data indicate a differential susceptibility of the X chromosome loci to the action of the alkylating compounds as compared to x-rays. The effect of dose and the nature of the genetic damage is also discussed. The alkylating compounds are most effective in the induction of small deficiencies, involving less than 7% of the length of the salivary gland X chromosomes. They induce 2-3 times as many small deficiencies as cytologically equivalent doses of X-rays. A tentative interpretation is proposed.

* Fahmy and Fahmy 1956 - [1364]


A differential genetic response to various mutagens was confirmed. Not only was this manifested in the different relative frequencies of the various types of mutations induced but in a selectivity for certain gene loci. A dose rate of 250 - 260

1980 Fahmy, O. G., Fahmy, M. J. X-RADIATION AS COMPARED TO CHEMICAL EFFECTS OF MUTAGENS

An outstanding feature of the x rays is the action of the genetic material. It is established by many different specific cloning loci in the action of the fungus. The technique used for treated males. Females to be irradiated or injected with x rays, are exposed to 80% or 90% of the lethal dose at the time of occurrence of the clone's frequency. A chemical induced visible increases in the effect of the x-ray, but with the fusion expectation, various mutagens.


The authors continue to use the very chemical agents in Drosophila gaster but a variable specific combination.


A significant increase in the f given for 7% between irradiation of lethal frequency, although the rearrangements.

1983 Frits-Niggli, H. ULTRASCHALL GASTER (Damage by ultrasound) 230-5. (in German)

The effects of ultrasound irradiation (180 kHz, 8 mA, 1 mm Al, melanogaster) were compared to the temperature to the exposure of x-rays, produces a delay in the ability to the secondary chem cells in the cell (or nucleus) observed biological effects in

1984 Frits-Niggli, R. BIOLOGISCHE Das 31-kV betatron. Form.

A preliminary study was made respectively. The ultra-hard to account for the differences in size, such as Drosophila gaster, LD50 for Drosophila gaster aged pupae, and for the frequency

322
and X-radiation damage in...

and X-rays. The results of exposure experiments have been published elsewhere. The effects of exposure to X-rays in mice and rats have been studied extensively. The effects of exposure to X-rays in humans have been studied less extensively. The effects of exposure to X-rays in mice and rats have been studied extensively. The effects of exposure to X-rays in humans have been studied less extensively.

1980

Fahmy, O. G., Fahmy, M. J. RESPONSE OF SPECIFIC GENES IN DROSOPHILA MELANOGASTER, TO X-RADIATION AS COMPARED TO THE PHENTYLAMINE-MUSTARD. Radiation Res. 9 (1965) 118.

An outstanding feature of the mode of mutagenic action of the alkylating compounds is that they seem to affect the genetic material differently from radiation (see reports of previous conferences). In order to establish how far this differential action operates at the gene level, we analyzed the degree of response of specific gene loci to the action of X-rays and a nitrogen mustard, viz., p-N-dimethylaminoethylphosphoramide. The technique used was that of scoring for certain sex-linked recessive "variants" in the F2 progeny of treated males. Female homozygotes for the variable sex were mated to males who had been irradiated or injected with the chemical mutagen, and the F2 daughters were scored for the marker genes. For both radiation and chemical experiments the following conditions were standardized: germ cells mutagenized (in spermatids), chromosome sample scored (50,000 per locus), and mutagenic dose given (inducing about 0.6 sex-linked recessive lethals). Some of the gene loci tested were the "classic" variants which are often encountered in radiation experiments and which also occur spontaneously, but others were "new," ones that occurred frequently in our experiments with various alkylating compounds. The majority of the chemically induced variants proved to be refractory to X-rays at the dose and time of sample utilized. Under the effect of the mustards, however, these genes did mutate with an incidence in reasonable agreement with the poison expectations. This adds excellent support to the principle of differential gene response to different mutagens.

1981

Fahmy, O. G., Fahmy, M. J. DIFFERENTIAL GENE RESPONSE TO MUTAGENS IN DROSOPHILA MELANO-
GASTER. Genetics 44 (1960) 1197-120.

The authors carried out a very extensive analysis of the mutability of specific genes after X-rays and chemical agents in Drosophila. Not only were significant differences observed between X-rays and chemical mutagens but a variable spectrum of sensitivity was obtained when different chemical mutagens were employed.

1982

Talk, A. DELAY IN JOINING OF X-RAY INDUCED BREAKS BY ANOXIA IN DROSOPHILA MELANOGASTER. Genetics 35 (1960) 309. (Abstr.)

A significant increase in the frequency of autonomous translocations could be demonstrated when anoxia was given for 1 hour between irradiations. Nitrogen treatment between irradiations did not significantly augment lethal frequency, although there was a small increase, probably representing lethals connected with gross rearrangements.

1983

Pitz-Niggli, H. ULTRASCHALLINDUZIERTE UND RONTGENINDUZIERTE BIOLOGISCHEN WIRKUNGEN IN DROSOPHILA MELANOGASTER. Strahlentherapie 85 (1960) 333-335. (In German)

The effects of ultrasonic irradiation (applied intensities: 0.1, 0.2, 0.5, and 1.75 W/cm² and of X-irradiation (250 Kev, 0 mA, 1 mrad AL, 23 cm target distance, 380 r/min) on eggs, larvae and pupae of D. melanogaster were compared and related to temperature shocks. In contrast to the effects produced by temperature shocks the responses to X-rays and to ultrasonic irradiation were analogous. Ultrasonic radiation, like X-rays, produces a delayed reaction, death occurring in later stages of development. The author speculates as to whether the biological effects of ultrasonic irradiation can be attributed to ionization, which leads to secondary chemical changes as in the case of X-rays. Since these chemical changes may occur in the cell (nuclear) as well as outside of the cell, the target theory cannot be applied to the observed biological effects in Drosophila. (B 27: 19631, 1962)

1984

Pitz-Niggli, H. BIOLOGISCHES VERHALTEN MIT DEM 25-ME-V-MEYTRON (Biological experiments using the 25-MeV deuteron). Forschung, 70 (1964) 22-30. (In German)

A preliminary study was made of differences observed following irradiation by 250 MeV and 31 MeV, respectively. The irradiation was less effective throughout. No reasons can yet be put forward to account for the differences obtained in different species. The desirability of testing objects of uniform size, such as Drosophila eggs, was emphasized. A comparison is made for both irradiation data for the Drosophila eggs aged 1 and 2 hours, the dose required to cause a 5% spread wing effect in 500-cells, and for the frequency of occurrence of lethal factors after irradiation with 2000 c of either radiation.
Guakden, M. B., Nix, M. 

**EFFECTS OF OXYGEN TENSION ON X-RAY INDUCED MITOTIC INHIBITION.**


The large neuroblast cells of the embryo of the grasshopper *Chorthippus brunneus* were given 64 r of x-rays while exposed to different tensions of O₂, namely, 100%, 25% (air), 2%, and 0% (N₂, CO₂, or vacuum). The embryos were made into culture preparations. The number of cells completing mitosis in a given period of time was determined, since 28 min is the average duration of mitosis (at 28°C) and since the treatment used do not affect this duration. The results indicate that the sensitivity of mitosis to radiation is reduced when cells are irradiated at the lower O₂ tensions. In other words, the duration of the period of complete mitotic inhibition (period after irradiation during which there are no cells in the mitotic stages) is shorter when cells are irradiated in 0 or 2% O₂ than when they are irradiated in 21 or 100% O₂. Experiments are now in progress to determine the sensitivity of cells to radiation in 2 and 10% O₂.


(An abstract of this paper also appeared in J. Tenn. Acad. Sci. 65 (1960) 269.)

Kaplan, W. D., Lyon, M. F.

**MUTAGENIC EFFECTS OF X-RAYS ON THE MUSEUM SPECIMENS.**


Bacon and Hare (RI. Acad. Mus. Nat. Hist.) made a survey of the effects of x-rays on the primate embryos. They found that the embryonic lethality is increased in the first 100-200 r. The results are consistent with the hypothesis that the x-rays cause a mutation in the chromosome structure, and that this mutation is then expressed in the next generation.

Barker, G. H., Kuenzel, H. A.,

**DESOPIEPA NAICH CYSTER (the use of cysite).**

*Nat. Hist.* **19** (1957) 241-244.

The rate of lethal mutation is given in tabulated form. The increase in the rate of mutation is due to the difference in the distribution of the mutant genotypes.

Hollander, A., Baker, W. J.

**ON THE X-RAY SENSITIVITY OF HORSE.**

*Horse Syst. Physiol.* **19** (1957) 241-244.

The results of the experiments on the effect of x-rays on the horse are given. The effect is due to the difference in the sensitivity of the different tissues to radiation.

Kuenzel, H. A., Hare (RI. Acad. Mus. Nat. Hist.) made a survey of the effects of x-rays on the primate embryos. They found that the embryonic lethality is increased in the first 100-200 r. The results are consistent with the hypothesis that the x-rays cause a mutation in the chromosome structure, and that this mutation is then expressed in the next generation.

Kuenzel, H. A., Hare (RI. Acad. Mus. Nat. Hist.) made a survey of the effects of x-rays on the primate embryos. They found that the embryonic lethality is increased in the first 100-200 r. The results are consistent with the hypothesis that the x-rays cause a mutation in the chromosome structure, and that this mutation is then expressed in the next generation.

Kuenzel, H. A., Hare (RI. Acad. Mus. Nat. Hist.) made a survey of the effects of x-rays on the primate embryos. They found that the embryonic lethality is increased in the first 100-200 r. The results are consistent with the hypothesis that the x-rays cause a mutation in the chromosome structure, and that this mutation is then expressed in the next generation.
CONCERN ON X-RAY-INDUCED I, cell. comp. Physiol. 41 (1953)

Fractionated mitotic inhibition in G, S or G 4 of x-rays in N 2, CO 2 or air, the living cultures made at 22°C by 0 2 tension in the absence of radiation was affected very little, but between 0 and 10% the duration of minimum mitotic activity was correlated with the length of treatment was negatively not significantly different from those of these cells to radiation involves radiation.

INDUCED TRANSLocations IN X-RAY INDUCED MITOTIC INHIBITION.


(Kenworthy, W.) Genetics 92 (1956) 277-96.

Survival rates were determined for 350 Habrobracon eggs x-rayed during mitotic metaphase I in oxygen, air, or nitrogen. Survival of eggs irradiated in nitrogen ranged from 64.0% at 300 r to 10.9% at 2900 r. Survival of eggs irradiated in air ranged from 58.3% at 300 r to 0% at 3500 r. Survival at 1518 r. Survival of eggs irradiated in oxygen ranged from 27.5% at 500 r to 0% at doses of 1058 r and above (0.6% survival at 1100 r). Survival rates were determined for 1850 Habrobracon eggs irradiated during mitotic prophase in oxygen or nitrogen. Survival of eggs irradiated in nitrogen ranged from 8.9% at 1700 r to 1.9% at 34,000 r. Survival of eggs irradiated in oxygen ranged from 70.0% at 1700 r to 1.3% at 34,000 r. Dose-effect survival curves for eggs irradiated in metaphase were exponential regardless of the gas in which irradiation took place. Dose-effect curves for eggs irradiated in prophase were not linear for the r x-ray doses given. Cytological studies of eggs irradiated with 1000 r during mitotic metaphase I showed no chromosomal abnormalities other than terminal deletions. The percentage of such abnormalities was lower in eggs irradiated in nitrogen than in those irradiated in air or oxygen. Comparisons of chromosomal damage with survival data suggest that both dominant and recessive lethals decrease when irradiation takes place in the absence of oxygen.

Kenworthy, W. THE EFFECT OF OXYGEN CONCENTRATION OF THE DOSE-ACTION SURVIVAL CURVES OBTAINED FOR HABROBRACON EGGS IRRADIATED DURING MEIOCYTE PROPHASE AND METAPHASE.


1965 LaChance, L. E. THE ROLE OF CHLORINATION IN THE PRODUCTION OF X-RAY INDUCED DOMINANT LETHALS IN HABROBRACON.


Four groups of virgin Habrobracon wasps, comprising (1) control, (2) EDTA-fed, (3) x-irradiated, and (4) EDTA-fed and x-irradiated, were compared for egg production and hatchability subsequent to treatment. The percentage of embryonic dominant lethals was calculated by the comparison of hatchability of the eggs from females given identical treatments, some mated and some left unmounted for the parthenogenetic production of haploid males. Data were collected throughout the reproductive life of the females. Those embryos which were derived from eggs in different stages of meiosis and which did not hatch at the time of treatment were identifiable on the basis of ovary morphology. Females were allowed only a single meal of the chelating agent, 0.1 M EDTA, at the diapause exit. In those groups which were fed the chelator and then irradiated, the dominant lethality was much greater than in the irradiated or the EDTA-fed groups. It was also much greater than could be expected if the two agents were independent in action or merely additive. Thus the action of the two agents is believed to be synergistic. The role of EDTA in enhancing induced genetic lethals is discussed and several pathways of action proposed. (from abstract.)

LaChance 1958 - (1961)

1966 LaChance, L. E. THE EFFECT OF CHLORINATION AND X-RAYS ON FECUNDITY AND INDUCED DOMINANT LETHALS IN HABROBRACON.


The effects of injected EDTA on radiation recovery and induction of embryo dominant lethals was studied in the wasp Habrobracon. It was found that recovery from temporary sterility induced by x-irradiation was retarded in those females which had ingested a meal of the chelating agent prior to the radiation treatment. The amount of dominant lethality induced in the germ cells of irradiated females was significantly increased by treatment with a chelating agent. (from abstract.)

LaChance, L. E. (North Carolina State Coll., Raleigh) STUDY ON THE GENETIC DAMAGE INDUCED IN THE REPRODUCTIVE TISSUES OF HABROBRACON FEMALES BY CHELATING AGENTS AND X-RADIATION.


Whereas low doses of irradiation have no effect on life span of females, the feeding of a chelating agent, EDTA, significantly reduced the life span of the females below that of controls. The ingestion of a chelating agent prior to irradiation resulted in an increase in the percentage of induced dominant lethals in the embryos. The increase in dominant lethals was greater in groups given either a chelating agent or x-radiation alone. Evidence of synergistic action of the two treatments is presented. The enhancement of the radiation effect was noted in both ovaries and yolk cells. After a radiation dose of 2000 r, Habrobracon females undergo a period of temporary sterility followed by a period of nodular recovery in egg production. EDTA ingestion prior to irradiation reduces the amount of recovery observed. The productivity in terms of larvae per female per day is significantly reduced and evidence of synergistic action of the two agents is presented. Cytological study of whole mounts of dissected ovarioles showed a degree of damage and degeneration in ovarioles which is attributed to the action of the chelating agent. Possible modes of action of chelating agents on genetic material are discussed. (from abstract.)


The protective action of low resolution hypothesis have been rate of chromosome aberrations of the bud and 3rd d after irradiation is concluded that the widest variations in the C effect on the various arrangements are induced by the rays. The effect of the C effect is presented.

Linsing, K. G. THE EFFECT OF PHOSPHATE-INDUCED RAYS.

p. Conference on Radiobiology, ed. London, Cramer and Bo Muller-Solden were irradiated, offing were analyzed, and variations were the rates of the lethals: intergenic (breaks) both chromosome breaks and

Linsing and Jonsson 1958 -

Linsing et al. 1958 - (1968)

Linsing et al. 1968 - (1989)

Murphy, W. W. THE EFFECT OF HABROBRACON IN RAYS.

Females were used to make 100 s. The results are given produced/any female, recent embryo lethals carried, and Habrobracon eggs irradiated (Papers presented at Marine I

Nakao, Y. THE EFFECT OF RAYS IN THE SILK WORM. JAE.
2388 Lace, W. M., Quastler, H., Land, E. F. BIOLOGICAL EVALUATION OF 20 MILLION VOLT ROENTGEN RAYS. V. RAY EFFECT IN DROSOPHILA. Amer. J. Roentgenol. 44, 8 (1939) 983-7.

The efficiencies of 20 MeV x-rays from a betatron and x-rays from a conventional machine operating at 100 and 200 peak kV in reducing the eye facet number in Bar-eyed Drosophila were determined. The weighted mean of the 20 MeV x-rays for different doses and different control facet numbers was 0.0119 facets/mm. While that of the 100 and 200 kV radiation for different doses, different dose rates, and different control facet numbers was 0.0041 facets/mm. The ratios of the mean efficiency of the 20 MeV x-rays to that of the 100 and 200 peak kV x-rays was 0.0139/0.0141 or 0.88. All dose measurements were made with a single thimble chamber. (EM XIV (9): 1795, 1931)

2389 Linn, H. MEGAPHÖN/VORHEM-HANDLING UND STRAHLLENINDUZIERTE MUTATIONSRATE BEI DROSOPHILA MELANOGASTER (Megaphon treatment and radio-induced mutation rates in Drosophila melanogaster). Annalen 5 (1934) 298-309. (In German)

Megaphon, administered alone or in combination with other substances, prevents damage to eggs in a recognizable extent, but does not reduce the spontaneous mutation rate in Drosophila. X-radiation was used. (Author.)

* Lining and Hanscom 1962 - [1965]

1400 Lining, K. G. EFFECT OF OXYGEN ON BRADIALTED MALES AND FEMALES OF DROSOPHILA. Hereditas 49, 5-4 (1964) 399-412.

The protective action of low CO2 concentrations during irradiation is not fully understood; a breakage and a reunion hypothesis have been proposed. The present study deals with an analysis of CO2 concentration on the rate of chromosome aberrations induced either in Drosophila sperm or in newly hatched male flies, or in oocytes. The study was conducted, and it is concluded that the variations in the breakability in various stages of spermatogenesis are not dependent on variations in the CO2 concentration. In oocytes irradiated in air, there is a decrease in induced mutations and more multimeiotic arrangements are found than in spermatogonia. The effect of oxygen is much greater in females than in males. The effect of the CO2 concentration during irradiation is discussed and a scheme of levels of possible effect is presented.


Male flies were irradiated (2200 r) in air or nitrogen atmosphere and mated to y w females. F1 offspring were analyzed, and the results discussed. The results of the recombination analysis of both male and female larvae of Drosophila melanogaster were used. The results of the recombination analysis are not the same as the rates of the break-dependent mutations, as in favor of a double origin of recessive lethals: (a) genetic (break-dependent) and (b) intragenic (singly break-dependent). It is concluded that both genetic and intragenic changes are affected by the degree of anoxia.

* Lining and Hanscom 1962 - [1965]

* Lining et al. 1966 - [1968]


Female flies were mated to males irradiated with a sublethal dose of x-rays, in air or nitrogen (4204 r in 100 r). The results are given in terms of the frequency of x-rays and x-ray-induced post-embryonic lethals carried, and visible mutations. The differences (when significant) were smaller than for x-rays.

(Paper presented at Marine Biological Laboratory)

* Oester, 1957 - [315]


X-rays in combination with urethane or mustard gas exhibit an additive effect as regards the formation of sex-linked recessive lethal mutations and chromosome breaks when applied to Drosophila melanogaster spermatozoa. Their action in combination on the formation of translocation is synergistic. The end of chromosomes broken by x-rays, mustard gas, and urethane are as capable of rejoicing with those produced by the same agent as the x-ray produced ones are of rejoicing with those produced by either mustard gas or urethane to form chromosomal rearrangements. (auth. summary)

* Oct. 1959 - [319]

* Plaine and Glass 1952 - [1948]

* Plaine 1955 - [2847]


L-Cysteine was fed to larvae carrying both a suppressor-tumour and a suppressor-tumour system to test its effect in combination with x-ray treatment and with supplementary L-tryptophan in the diet. Cysteine itself had no effect on erupt eye or on the incidence of melanotic tumors. Fed before or after x-ray treatment, cysteine greatly reduced the reduction effect which blocks the action of the suppressor gene and thus counteracts both tumours and erupt eyes. Cysteine was more effective in countering the erupt eye effect when fed before the x-ray treatment, but it appeared to be more effective against the tumorigenic effect if fed after the x-ray treatment. The greatest protective effect was obtained when cysteine was fed both before and after the x-ray treatment, the incidence of tumors being reduced from 78 to 13% and that of erupt eyes from 90% to 14% when the larvae were x-rayed 24 h after hatching. Cysteine, to a considerable degree, counteracted the harmful effects of x-rays on viability, particularly those which occurred during the pupal period. Cysteine likewise counteracted in all respects the effects of feeding supplementary tryptophan. The feeding of L-tryptophan (0.5%) plus L-cysteine (0.1%) led to a significant reduction in the incidence of tumors from 63% to 36% and in the incidence of erupt eyes from 96% to 7%. The toxicity of tryptophan, during the pupal stage, was greatly reduced when cysteine was added to the medium. In all respects, the interaction of tryptophan with O3, cysteine is strikingly like that of x-rays with O3 and cysteine. This might imply the operation of a similar mechanism in these cases. (auth.)


The effect of treatment with versene solution before irradiation on the frequency of chromosome breakage was determined by counting the number of dicentric bridges in the first mitotic metaphase cells of the grasshopper, Gomphocerus expeditionis. In the controls (treated with 0.27 percent saline plus 66 r of x-rays), 10, 18, 20, 27 bridges were recorded as compared to 8.29 ± 0.61 percent in the treated series (0.17 M versene solution in 0.27 percent saline plus 66 r of x-rays). The unirradiated versene treated group showed no bridges in 801 first metaphase cells. It was concluded that versene is a definite though feehle protector of radiation-induced chromosome breaks in our material. (auth.)


Recent experiments by Baker and Edington have shown that the x-ray induction of chromosome translocations, sex-linked recessive lethal mutations, and dominant lethal mutations in Drosophila melanogaster is oxygen concentration in the atmosphere in which the flies are irradiated. The data agree with Haldane and Lea's (1947) mathematical theory that the coefficient of break production depends on oxygen in much the same way as several other radiobiological effects. It is suggested that some compound is produced (perhaps H2O2) which can cause a break if it diffuses to the chromosomes in sufficient concentration. (BA 31: 193, 1957)

1408 Shaw, E. L. PROTECTION IN GRASSHOPPER NEURON IN neuroblast cultures of the neurons against x-ray-induced mitotic inhibition of 10^-4 M sodium by the mitotic inhibition can be reduced if sodium is reduced to 10^-6 M. In the present study, x-ray inhibition of mitotic activity occurs in the present study, x-ray inhibition of mitotic activity occurs, but not at least as the sodium level increases. (auth. summary)

1409 Sobels, P. H. CHEMICAL ABERRATION BY X-RAY IN DROSOPHILA. Nature 151, 387 (1947)

A survey was given of studies on the effect of catalase-inhibitors on x-ray-induced mutation rate in Drosophila melanogaster sperm 4-7 days after treatment by pretreatment with sodium hydrogen peroxide in the p

1410 Sobels, P. H. THE EFFECT OF VERSINE ON X-RAYS. Nature 151, 387 (1947)

Drosophila males were kept at 25°C from 1-7 days prior to x-rays with different concentrations of versene. The survival was significantly reduced by versene, while the mutagenic effect was also reduced.

1411 Sobels, P. H. ORGANIC TREATMENT WITH DITHIOTHREITOL X-RAYS. Nature 167, 194 (1951)

A particular type of sperm-irradiation also shows a pronounced reduction in the formation of precursors of dithioreitol.

1412 Sobels, P. H. THE EFFECT OF VERSINE ON DROSOPHILA. Experientia 6, 181 (1950)

Drosophila males were exposed to 0.033 x 10^-4 M of formamide or versene at 4°C in different groups. The results showed that versine is effective in reducing the formation of precursors of dithioreitol, while dithioreitol is less effective.

1128
CHEMICAL MUTAGENS. Z. Naturf. 16


In neuroblast cultures of the embryo of the grasshopper Cryptomphalus virdis fasciae (De Geer) protection against x-ray-induced mitotic inhibition is conferred by pretreatment with sodium hydroxylite. A concentration of 10^{-9} M sodium hydroxylite almost completely prevents the inhibition of mitosis caused by 8 r. The mitotic inhibition caused by 32 r is only partially prevented by the same pretreatment. The dose-reduction factor is 32 r ≈ 3. The rate of recovery is the same in the cultures that received 32 r and those that were pretreated with 10^{-9} M sodium hydroxylite and in those that were irradiated but received no pre-treatment. The earlier recovery of the pre-treated cultures is accounted for on the basis of less demonstrable inhibition of mitotic activity by the irradiations. The primary damage responsible for mitotic inhibition at low doses, and at least partially at high doses, may be due to the oxidation of nucleic acid components by HCl or similar oxidizing radicals whose formation is dependent on the presence of oxygen during irradiation. (auth. summary)


A survey is given of studies conducted from 1954-1956 at the Institute of Genetics of the State University Utrecht. In view of the possible role of O_2 and H_2O_2 in the production of x-ray-induced mutations, the effect of catalase-inhibiting mutation rates has been studied. The results showed an enhancement of the induced mutation rate in immature germ cells after pre-treatment with cyanide, azide, and by treatment with dihydroxyethyl peroxide and formaldehyde. The effects of post-treatment with cyanide and their significance are discussed. Similarities between radiation- and chemical mutagenesis are considered briefly. 22 references are cited. (See also Prog. in Radiation Biol. 5, 1 (1960) 68-93)


Drosophila males were used with a 0.008 M solution of potassium cyanide prior to x-radiation with doses varying from 600-3000 r. Compared to the controls, which were only x-rayed, the frequency of sex-linked lethals after cyanide pre-treatment was significantly increased in germ cells which formed mature sperm 4-7 d after treatment. A similar enhancing effect on the x-ray induced mutation rate was obtained by pretreatment with sodium azide. The results are tentatively ascribed to an increased production of hydrogen peroxide in the pre-treated irradiated germ cells. (auth. summary)


A particular stage of spermatogenesis which is characterised by peak sensitivity to the mutagenic action of x-radiation also shows a preferential response to pretreatment with an organic peroxide and other compounds which are thought to act via peroxide formation. It appears reasonable to suppose that the formation of peroxides accounts for at least part of the mutagenic action of x-rays on the genetic material of Drosophila.


Drosophila males were exposed to 1000-2000 r of x-rays, after injections of low doses (0.28 mm α of 0.058-0.050 M of formaldehyde. The incidence of sex-linked recessive lethals was determined by the Miller-B method. In solution was at 100-640 r/min and 5 mm, at 244 p, 0.5 mm thick with 1-mm Al filter. Comparisons of mutation rates for flies treated with HCHO alone, with x-rays alone, and with both show that the pretreatment with the low concentrations of HCHO enhances the mutagenic action of x-rays. Mature sperm were obviously affected as well as cells which were spermatogonia at the time of treatment. It is suggested that the HCHO inhibits catalase and also forms peroxides, the peroxides are taken to semi- tile the chromosomes to x-rays.

Injection of 0.02 M formaldehyde prior to irradiation with 1700 r, caused, from the third day onwards a significant enhancement of the mutation rate induced by irradiation. Fully mature sperm, however, did not respond any more to the potentiating effect of formaldehyde on x-ray mutagenesis. The findings support the assumption that an increased production of peroxides exerts a potentiating effect on the mutagenic action of x-rays in immature germ cells. Pretreatment with 0.018 M of dihydroxyethyl peroxide also caused a pronounced enhancement of the mutagenic effect of x-rays. A comparison with the effects of cyanide and ascorbic acid shows that all these substances exert their potentiating action in one particular stage of spermatogenesis, characterized by peak sensitivity to the mutagenic action of x-rays. The observed correlation between peak sensitivity to irradiation and preferential response to pretreatment with an organic peroxide, and substances which are thought to increase the content of peroxides in the cell, suggests that the formation of peroxides may account for at least part of the genetic effects of x-rays in Drosophila.


The genetic effect of treatment of Drosophila males with HCN after irradiation with x-rays was investigated by studying sex-linked lethals and translocations involving the Y, second, third, and fourth chromosomes. A high dose rate of 2200 r/min to a total of 1650 r, and a low dose rate of 500 r/min to a total of 1180 r were used. HCN had no effect on lethals after the low dose rate, but after the high dose rate it increased the rate of lethals in the stage of spermatogenesis with peak sensitivity. HCN also increased the rate of translocations at both dose rates at the sensitive stage. These data indicate that the cyanide-produced increases in lethal rates cannot be caused by gross chromosome rearrangement, but are probably caused by catalase inhibition leading to greater accumulation of mutagenic peroxide at the high than at the low dose rate. This catalase cannot be in the form of a short-lived radical since the catalase inhibition was still effective 6 min after irradiation ceased. This theory is also consistent with previous results on pretreatment with catalase inhibitors. (CA 59: 20209h, 1963)


Post-treatment of Drosophila males with cyanide significantly enhances the rate of sex-linked lethals induced by x-rays at a high (1800 r/min) but not at a low dose rate. The effect is mainly restricted to stages of spermatogenesis with peak radiosensitivity. It is suggested that catalase inhibition favours the accumulation of radiation-produced peroxide which is formed in greater concentrations at high doses than at low doses. The fact that catalase inhibition was still effective 6 min after irradiation was taken as evidence that short-lived radiation-produced O_2 and H_2O radicals, and N_2O_3, in an excited state presumably act on the active mutagenic agents. These findings could also explain that earlier experiments, even at low dose rates, cyanide and ascorbic acid, if administered as pre-treatment, enhance the mutagenic effects of irradiation. (auth. summary)


Flies were pre-treated with HCN in N_2 or O_2 and then irradiated in N_2 or O_2, respectively. It is suggested that inhibition of catalase by cyanide favours the accumulation of mutagenic peroxides produced by the irradiation. Since O_2 would be essential for the formation of peroxides by irradiation, the fact that cyanide treatment (pre- or post-) only effects spermatids is in keeping with the hypothesis, because it has been shown that more O_2 is available within spermatids than within mature sperm.


Post-treatment with hydroxycyanic acid results in a significant increase of the mutation frequency in spermatids. If x-radiation is delivered at a high dose-rate, but not after irradiation at a low dose-rate. A greater overall genetic effect of high intensities, post-reat increase in lethal frequency genes mutations and post-oxidation tension are present if high-intensity radiation responsible for repair of fusions then seems a metabolic system independent of N_2 is equal to that after r.

Sobels, F. H. EFFECTS TO X-RAYS IN DROSOPHILA. Post-treatment with hydroxycyanic acid, if x-radiation is delivered at a high dose-rate, increases the frequency of mutations and post-oxidation tension. Var. Sumarokov 1968. (126)

Takada, G. SOME EFH DROSOPHILA CINEREU. Entomology, Michigan 8.

The effect of infra-red a (For the physical aspect). 1960

Talmi, T. N. Adam MELANOPHUS DIFFERENTIALE. Melanopus differentiae developed normally, if at 20°C in air, negative gap cold treatment for 6 may show development unlike nucellar appear normal, due to x-radiation does not, eggs is theoretically used, helical standstill. Evident energy release is possible stopped, and under such (Abstract of paper presented Ohio 27-30 Dec. 1960)

(Talmi, T. N. ATRI Conference on the Peac...
greater overall genetic effect of intensity per se has not been observed. Following radiation at both low and high intensities, post-treatment with cyanide increases the frequency of translocations in spermatozoa. The increase in lethal frequency due to post-treatment may refer not only to position-effect lethals but also to gene mutations and possibly small deletions. Data relating differential sensitivity in successive broods to oxygen tension are presented. Post-treatment with cyanide is equally effective in raising the mutation rate if high-intensity radiation is given in pure N₂, as in O₂. It is assumed that cyanide inhibits a mechanism responsible for repair of the initial radiation damage. Recovery from changes leading to lethal gene mutations then means a metabolic process, possibly connected with respiratory energy. Injury to this repair system is independent of oxygen tension, and the separable fraction of the initial damage after radiation in N₂ is equal to that after radiation in O₂.


Post-treatment with hydroxylate acid results in a significant increase of the mutation frequency in spermatozoa, if x-radiation is delivered at a dose-rate of 2200 r/min (intense radiation), but not after a dose rate of 160 r/min (mild radiation). In the absence of cyanide no dose-rate effect was observed. Following x-irradiation, the frequency of translocations in spermatozoa, unlike that of lethals, is significantly increased by cyanide. Various interpretations are proposed.

Sutarmadjja 1968 - (1968)


The effects of infrared and ultraviolet light, and of x-rays and accelerated electrons were investigated.

(For the physical aspects of the work, consult Baker, 1953: Ph. D. Thesis)


Melanophis differentials grasshopper embryos placed in an atmosphere of N₂/CO₂ (95/5) for 24 h developed normally. If these anoxic embryos are irradiated at 20,000 r after 24 h of anoxia and placed at 25°C in air, negative growth does not occur as with eggs irradiated in air. Upon interrupting diapause by cold treatment for 3 months these embryos, when returned to 25°C and on being irradiated under N₂/CO₂, show development unlike those irradiated in air. Thus, they undergo blastokinesis, increase in size, resting nuclei appear normal, respiration is normal, initial resums, the embryo grows, and the oxidative enzyme due to x-radiation does not appear. They do not hatch, however. Since any O₂ which is dissolved in the egg is theoretically used up in the irradiation effect on these embryos under N₂/CO₂ is complete metabolic standstill. Evidently, in orthoptera no anaerobic glycolysis takes place, so that no known form of energy release is possible. Since the oxygen substrate moiety is interrupted, we may regard metabolism as stopped, and under such conditions irradiation damage is at a minimum. (From abstr.)


(An earlier report appeared on p. 58-8 in ANI-4688, Argonne National Lab., Lemont, III. Progress Report, 4 July 1960. An increase of about 8% in hydrochloric oxidase over a period of 14 d was reported for diapause eggs exposed to 6000 r of x-rays in normal room atmosphere.)


Grasshopper embryos irradiated in air undergo negative growth. The degree of negative growth is less if the embryos are irradiated in 95% O₂/5% CO in the dark, but not in the light. The protection is greater under anaerobic conditions. Cyanide protects if administered after irradiation, but not prior to it and during irradiation. Eggs that have high tetrasodium-15 oxidase capacity are more resistant. It is suggested that there may be a relationship between the resistance of a tissue to irradiation and its dehydrogenase content; also, that

381
Irradiation protection is dependent upon the hydrogen and electron transfer of tissues and cells. (Essentially

1423 Stauff, H. ZUM PROBLEM DER WIRKUNG VON VERBÜTTERTEM EISENSACCHARAT AUF DIE DURCH
SÜNTGENSTRAHLEN INDUZIERTE MUTATIONSRATE BEI DROSOPHILA MELANOGASTER (Concerning
the effect of feeding iron-saccharate on the x-ray-induced mutation rate in Drosophila melanogaster).
Z. Indukt. Abstramm.-Vererbung 9, 3 (1969) 355-392. (In German. Summary in English)

The increase in x-ray-induced rate of recessive sex-linked lethals in Drosophila melanogaster by feeding
iron-saccharate, reported previously, had led to several conclusions about the participation of indirect
mechanisms in the radiation-induced mutation process. The effect proved irreproducible in large-scale
experiments. The earlier genetic and radiation procedures were repeated, and in some experiments
further parameters (translocation, state of maturity of the irradiated germ cells, feeding of iron-saccharate)
were considered. The discrepancy in results is probably due to the fact that the earlier technique did not
allow for the dependence of the mutation rate on the state of maturity of the irradiated germ cells.

1425 Vaterling, H. W. VERGLEICH DER WIRKUNG VON SÜNTGENSTRAHLEN UND STICKSTOFFDÄTUNG
AUF ZWEI-Stündige DROSOPHILA-MELANOGAster (Comparative studies on the effect of x-rays and that of nitrogen
mustard on 2 h Drosophila eggs). Strahlentherapie 82, 2 (1955) 195-204. (In German)

The quantum-mechanical conception makes it possible to compare chemical and physical noxae.
The noxious effect of various concentrations of nitrogen mustard on 2-h Drosophila eggs was determined
(after 24 h exposure at a constant temperature). The lethal ratio of various x-ray doses was also established.
As a half-value dose (L/2), 14-15 mg nitrogen mustard is approximately equivalent to 190 r; 5 mg
nitrogen mustard (0.4% lethality) is equivalent to 99 r; 30 mg nitrogen mustard corresponds with 40 r (lethal
ratio 94 and 87%, respectively). The use of higher concentrations than 30 mg nitrogen mustard does not
increase the effect. (EM XIV (9): 15, 1956)

1424 Whiting, A. R. FREQUENCIES OF DOMINANT AND RECESSIVE LETHALS INDUCED IN HABROBACON
EGGS BY X-RAYS IN AIR AND IN NITROGEN. Genetics 58 (1953) 701.

Eggs x-rayed in late metaphase I show high rate of terminal deletions correlated with dominant lethal
effects. Reccessive lethal rate is low. Chromosomes in this stage appears to be under tension and are not in
contact. Dominant lethal rate may represent total original breakage because while tension related lethals
may result from minute changes within chromosomes. Eggs (ho) from irradiated unmated females
which hatch have no lethals. Surviving daughters (2n) from females mated to untreated males, when bred
untreated, can be classified on basis of hatchability of their eggs into those with no recessive lethals (100% hatchability),
those with one (50% hatchability), etc. Majority of lethals set before hatching. Unmated females were exposed to 1120 r in a current of air or nitrogen, the latter during irradiation only, about
3 min. Results are given. This biologically equivalent dose in air for nitrogen data is about 400 r. The change in rates of both dominant and recessive lethals under conditions of this experiment suggests that there is a decrease in breakage in nitrogen. (From auth.)

(Abstract of paper presented at the 1955 meeting of the Genetics Society of America, Boston, Mass.,
25-27 Dec. 1955)

1425 Whiting, A. R. THE EFFECTS OF OXYGEN ON THE FREQUENCY OF X-RAY-INDUCED MUTATIONS IN

Habrobracon metaphase I eggs were x-rayed in atmospheres of air and nitrogen, the latter being administered
only during irradiation. Dominant embryo lethals, recessive embryo and postembryonic lethals, and visible
mutations were recorded. All types were reduced at the same relative frequency in nitrogen, 506 r in air
producing almost identical percentages of mutations as 1120 r in nitrogen. This leads to the conclusion that
reduction in oxygen concentration reduces primary breaks and that other factors influencing final conditions
are unchanged in the irradiated cell.

1426 Whiting, A. R., Murphy, Wm. E. RESPONSES OF XRADIATED HABROBACON EGGS AND SPERM TO
ANOKIA, AND THEIR THEORETICAL SIGNIFICANCE. Radiation Res. 2 (1956) 386-9, abstr. 143.

Eggs in first metaphase and prophase and mature sperm were x-rayed in air and in nitrogen, the latter
administered during irradiation only. Dominant and recessive embryo and postembryonic lethal and
visible mutations were recorded. In all, 8861 eggs were observed. In the nitrogen sets, dominant
lethals, the result of x-ray reduction in the same proportion restoration. This affords as an explanation that
radiation should remain constant, irradiation is consistently low greater responses to irradiation with amount of oxygen less peroxide is toward.

1427 Whiting, A. R., Murphy, Wm. E. OF HABROBACON TO AT Both
All types of x-ray-induced fewer in atmospheres of n
at.
and with nochromal late decreased in M 30 to 0 abundance of dominant as in amounts of cytoplasm than the "random" hypobr
sensations. (EM 51: 120

The present experiments I oxygen, no saturation of interpreted to indicate th
in oxygen and saturation.
Alternatively, if one of which is exhausted difference between 0 and is similar to the one prop and remaining in Vida for
breakage is less severe.

1429 Yost, H. T., Jr. BENESY. DROSOPHILA MELANOGAster.
Data are presented which effect of ionizing radiat
radiated eggs over is on the chromosomes.

1430 Young, W. J., Yost, H. INFRARED RADIATION MUTATION RATE IN D

Retreatment with infrared mutations induced by x-rays infrared are favourable, chromosomes with two al
and other findings and results from chromosome radiation actng alone or

332
lethals, the result of irreparable chromosome breaks (terminal deletions with lateral chromatid fusion), are reduced in the same proportion as other lethal changes caused by permanent chromosome alteration surviving restitution. This affects evidence for the breakage hypothesis. Also, if the reunion hypothesis were correct as an explanation of lower x-ray-induced change in lowered oxygen, the percentage of irreparable changes should remain constant. Data on visible mutations are too scanty to be significant, although their rate of induction is consistently lower in the nitrogen series. Larger cells, metaphase and prophase eggs, show a greater response to irradiation in nitrogen than do sperm in the reduction of lethal mutations. This correlation with amount of cytoplasm (fatter) is perhaps significant from the point of view of the theory that hydrogen peroxide is involved in indirect effect of x-rays on chromosomes.

1427

Wisting, A., Murphy, W. E. DIFFERENCES IN RESPONSE OF IRRADIATED EGGS AND SPERMATOZOA OF HABROBRACON TO ANOXIA. J. Genetics 52, 2 (1950) 297-308.

All types of x-ray-induced mutations of Habrobracon eggs in prophase I and M I and in spermatocytes were lower in atmospheres of nitrogen than in atmospheres of air. Dominant lethal mutations, apparently associated with chiasmatidal breakage and lateral sister union and with tetrad (conditions which prevent restitution) decreased in M I eggs in the same ratio as did recessive lethal and visible mutations. A consistently greater abundance of dominant and recessive lethals in eggs than in spermatocytes may have resulted from differences in amounts of cytoplasm and dissolved oxygen. The data appear to favor the "breakage" hypothesis, rather than the "reunion" hypothesis, to explain the protective effect of anoxia in x-ray-induced chromosome aberrations. (Am. J. Bot. 33: 580-16, 1947)

1428


The present experiments have demonstrated that, when the radiation is delivered at 1.0 atmosphere of oxygen, no saturation of the oxygen-sensitive system is achieved in Drosophila sperm. The results may be interpreted to indicate that at 0.2 atmosphere of oxygen and 0.06 r of x-rays (where living and co-workers had an approximately 25% reduction in oxygen-pressure of a cell) the component limits the amount of oxygen that may accumulate. Alternatively, the results are also consistent with the existence of two oxygen-sensitive systems, one of which is exhausted by 1000 r at 0.2 atmosphere of oxygen and the other of which is insensitive to the difference between 0.0 and 0.2 atmosphere but is sensitive to 1.0, 5.0 atmosphere of oxygen. This model is similar to the one proposed to account for the effect of oxygen tension on induced chromosome breakage and reunion in Vicia faba, in which a rejoining system is extremely sensitive to oxygen tension, whereas breakage is less sensitive. (from such summary.)

1429

Yori, H. T., Benrey, R. N. THE EFFECTS OF COMBINED RADIATIONS ON CROSSING OVER IN DROSOPHILA MELANOGASTER. Genetics 45 (1957) 147-160.

Data are presented which show that infra-red radiation delivered for 24 h at 10°C is unable to modify the effect of ionizing radiations, such as x- or y-rays, on the induction of crossing over. The problem of induced crossing over is considered in the light of an hypothesis that the effect is upon the coiling pattern of the chromosone.

1430


Pretreatment with infra-red radiation does not increase the number of sex-linked recessive lethal or visible mutations induced by x-radiation, even though the environmental factors known to influence the action of infra-red are favourable. Evidence on studies of the lethals failed to indicate any significant portion of the chromosomes with two or more lethals resulting from the combined radiations. It is concluded from these and other findings and from theoretical considerations that recessive lethal and visible mutations do not result from chromosome breakage and that neither type of mutation is to be expected as a result of infra-red radiation acting alone or in pretreatment before x-radiation. (from such summary.)
I - E. Radiation Effects on Insect Populations


A brief note comments on some observations reported on salivary chromosomes from irradiated Drosophila populations (cf. Paget, 1954). It is pointed out that the relative frequencies of different aberrations are not solely the results of differential selection but also determined in part by a higher rate of origin of inversions than of translocations. The average selection pressure against the inversions must therefore be somewhat greater than Paget estimated on the basis of equal rates of origin.

1432 Auerbach, S. L., Crowley, D. A., Jr., Engelmann, M. D. EFFECTS OF GAMMA RADIATION ON COLUMBIA POPULATION GROWTH. Science 126, 9274 (1957) 614.

Experiments were started with 81 reproducing population units of 10 individuals each of Prosope's Mitula Pell. The effects of radiation (single doses ranging from 3000 to 7000 r) from a Co-60 source were examined by checking on population size in 60-hour counts of individuals at food points and by counts of total numbers at the termination of the experiment. All population units appeared to have an initial threshold period followed by the typical phase of exponential growth. The effect of radiation seemed to be chiefly one of lengthening the threshold period, i.e., a lag effect.

(An earlier abstract was published in Biol. ent. Soc. Amer. 9, 3 (1956) 17, abstr. 24, by Auerbach and Engelmann)

* Bonner 1957 - [974]

* Bonner and Jonson 1967 - [976]


A study (intended to be preliminary) is described on the way in which selection pressure interacts with irradiation effects. Differences in strength of selection pressure between different populations of D. melanogaster were checked and maintained by larval competition. It was found that populations with a low selection pressure were much more difficult to keep alive than those with a strong one. When the accumulated dose had reached a certain level, the viability of all populations seemed to increase with further increase in accumulated dose, but much more quickly in populations with strong selection pressure than in the others.

Despite strong indications of an effect of selection pressure, the various tests so far performed (e.g. on egg-laying capacity, hatchability of eggs, fertility of males, larval competition, and on the number and spread into the population of lethal genes) have not shown any clear-cut differences between the populations.

* Clayton and Robertson 1961


Within separate population (as defined) all flies of each generation were irradiated under a common x-ray beam with 1500 r. The technique is described. It was attempted to collect 6000 - 6500 larvae per generation from each population. Results of the various experiments are given graphically for populations with low and with strong selection pressure. Certain consistent trends were observed and discussed.


This paper is a continuation of work reported earlier by the authors (Hereditas 44 (1968) 370-406), on the effect of selection pressures of different strengths on populations of D. melanogaster which had been subjected to x-rays. Experimental data are presented as graphs and an analysis of lethal chromosomes under prevailing conditions is given in tabulated form, as is the frequency of sterile males. The data obtained confirm earlier results.


The note is a searching compilation which is probably also an exercise not made sterile any or pollygamy exist in the kannibulayar are cited.

1437 Bazzini-Traverso, A. A. S 2nd UN International Conference

In a study on the induction of i was shown that x-rays can in the study of the flies, grow, that only variants which a high polygene mutations in ant increase of variability in the variability due to induction of new genetic variability is.

(This paper was also published et al.), London, Perg.

1438 Carson, H. L. EFFECT OF SELECTION. (abstr.) Gen.

Four replicate populations of a change schedule are rigid are described. The irradiated mean size of the flies in the decreased competition for situations quickly rose again to t.

* Clayton and Robertson 1950

1439 Cunha, A. B. da, Toledo, J Gama, M. R., Fisico del CA RADIATION-INDUCED LET International Conference on (CF. Prog. nucl. Energy, 5

Cunha, A. B. da, Toledo, J Gama, M. R., Fisico del CA RADIATION-INDUCED LET International Conference on (CF. Prog. nucl. Energy, 5

Cunha, A. B. da, Toledo, J Gama, M. R., Fisico del CA RADIATION-INDUCED LET International Conference on (CF. Prog. nucl. Energy, 5

Cunha, A. B. da, Toledo, J Gama, M. R., Fisico del CA RADIATION-INDUCED LET International Conference on (CF. Prog. nucl. Energy, 5

The authors tested the viable subjected to natural select induced lethals. The data similar in their effects as "

334
GAMMA RADIATION ON PROTOZOAN mitosis of Drosophila melanogaster.

Three populations of Drosophila melanogaster were irradiated with a photon source and examined for mitotic activity. The results showed a decrease in mitotic activity with increasing radiation dose.

Bennet, R.C. von. POPULATION CONTROL BY RELEASE OF BRIGHT MALES. Science 137 (1962) 875-876.

The note is a searching comment on an article by Kauppi (Science 130 (1955) 902). The effect of radiation which is probably also the most important in insect control is the induction of dominant lethality in the sperm, and not male sterility. With dominant lethality the results obtained are the same, whether monogy- any or polygyny exist in the insect population. Data from work on Drosophila, Houseflies and Calliphora hominivora are cited.


In a study on the induction of polygenic mutations in artificial populations of Drosophila melanogaster, it was shown that x-rays can increase the genetic variability of traits affecting the physiology and the morphology of the flies, and that natural selection is capable, under experimental conditions, of accumulating these variations which lower the fitness of the individuals. Data are tabulated. Data on the induction of such polygenic mutations in artificially selected strains are given graphically. Genetic analysis showed a marked increase in variability in the irradiated lines, exhibited both at the phenotypic and genotypic levels. A new variability due to induction of polygenic mutations affecting the selected traits may be observed. The origin of new genetic variability is discussed.


Carron, H.L. EFFECT OF BRADIZATION ON ARTIFICIAL POPULATIONS UNDER STRONG NATURAL SELECTION. (abstr.) Genetics 44 (1959) 940.

Four replicate populations of Drosophila melanogaster were run in vial populations in which food, space and change schedule were rigidly controlled, producing stringent natural selection. The conditions of irradiation are described. The irradiated populations declined precipitously in number but less in biomass. Thus, the mean size of the flies in the irradiated populations increased sharply; this appears to be a simple effect of decreased competition for food. During the two periods of irradiation, the experimental populations quickly rose again to the level of the controls but did not surpass them. (From abstr.)

Clayton and Roberson 1955 - [1957]


The authors tested the validity of the hypothesis that the lethal genes present in natural populations, and subjected to natural selection for generations, are less deleterious in the heterozygous condition than newly induced lethals. The data obtained do not support this. X-ray-induced and wild lethals are shown to be similar in their effects as well as in their frequencies in natural populations.

50

(See Diss. Abstr. 15 (1958) 2121)

1443 Gregg, T. G. (Univ. Texas, Austin) STUDIES ON EXPERIMENTAL POPULATIONS OF DROSOPHILA ANANASSAE DERIVED FROM X-RAYED NATURAL POPULATIONS. Diss. Abstr. 13 (1959) 2217.

Subpopulations of D. ananassae taken from populations on various smalls in the Marshall Islands in 1955 and 1957 were maintained in the laboratory in different types of experimental populations. These and a series of experiments are discussed. The results are shown to demonstrate that the low viability levels observed elsewhere (Hart and Ronggla populations, 1955) were actually the results of radiation from the thermonuclear tests 15 months previously and not due to normal population fluctuations.


Part of correspondence between von Bertalanffy and the author concerning the relative effect of monogamy and polygamy on the application of the sterile-male technique of population control.

(See Science 129 (1959) 902, and Biol. Rev. 31 (1956) 276.)


Some data is presented concerning the frequencies of chromosomal aberrations within several experimental populations of Drosophila melanogaster. Following irradiation with x-rays, salivary gland studies were carried out, and the frequencies of inversions and translocations investigated. They were found to be equal in the case of D. melanogaster.


The behaviour of second chromosome recessive lethal producing loci was studied in three experimental populations of Drosophila melanogaster. Of the three populations, one was a large population (~ 10,000 individuals) subject to chronic irradiation; one was a small population (~ 1000) slightly irradiated; and one was a large population receiving no treatment. The effect of genetic drift operating in the small population was determined by observing the allelic states of the lethals taken from the three populations and by analyzing the lethal accumulation curves in the populations. Also, three populations were estimated for each population. These parameters were the effective population size, the mean selection coefficient of heterozygotes between lethal and non-lethal alleles, and the mean mutation rate per locus. The estimates showed that (1) the small population might have a genetically effective size less than its absolute size, and (2) the selection against heterozygotes was affected neither by population size nor by irradiation, but was of the same order of magnitude as those measured in several wild populations of Drosophila. (*epch*)


This paper describes the start and the first preliminary results of an experiment on the influence of selection pressure on irradiated populations of Drosophila melanogaster. The populations included in the experiment emanate from one stock of non-irradiated wild type flies made homozygous for the three large chromosomes. The adult flies are kept in cages. Their progeny, in the stage of freshly hatched larvae, are collected and transferred to vials with a standard amount of food. The differences in selection strength are checked by larval competition. Thus in the populations with a low selection pressure 25 larvae are transferred to each vial, while the corresponding amount of larvae for those populations with a high selection pressure is 200 and 400 per vial. The populations are further divided into two series. In one there is no control of the number of offspring per female, whereas in the other larvae are collected from groups of five females, the progeny of which never including files are irradiated by an acute differences in the case with populations alive. The populations those with a strong selection by of all populations seemed to be much quicker in the populations irradiated second chromosome.

(Abram of paper presented at 1449


Selection for high and low melanogaster to determine if adherence (that in selection for high mean generation) were effective to almost ineffective. The selection, in the irradiated is observed. This decrease it is associated with the loss of the own number. It is stabilized at a higher level the fitness is observed, ' tailed for plant and animal bension'.

1451 Schoenfroth, R. E. ON THE RELATIONSHIP OF SELECTION PRESSURE ON POLYGENIC RADIATION RESISTANCE. Radiation Res. 1 (1958) 61-64.

X-ray and other irradiation treatments are a very good variability for polygenes trait ability. X-ray treated irradiating the observed effects, (See 1452)

progeny of which never included more than 20 flies per group. After the emergence of a new generation all flies are irradiated by an acute x-ray dose of 1.5 k. An effect of selection pressure is strongly indicated by the differences in the case with which it has been possible to carry through the routine work and to keep the populations alive. The populations with a low selection pressure were much more difficult to keep alive than those with a strong selection pressure. When the accumulated dose had reached a certain level, the viability of all populations seemed to increase with further increase in accumulated dose; the increase, however, is much slower in the populations with strong selection pressure than in those with low pressure. When testing irradiated maternal genotypes a marked dominant effect in viability was found.

GENETIC STUDIES OF BRADYHERM POPULATIONS OF DROSOPHILA MELANOGASTER (see references for details).


Wallace, B. GENETIC CHANGES WITHIN POPULATIONS AFTER X-RADIATION. Genetics 19 (1951) 268-76.

Wallace, B. STUDIES OF POPULATIONS EXPOSED TO RADIATION. (later) Science 115 (1952) 437.


Previously reported results were analyzed in detail and extended.


Wallace, B. THE ROYAL INSTITUTE OF BIological Sciences. An analysis was made of the viabilities of populations of Drosophila melanogaster. (Also published as AECU-1465.)

Wallace, B. THE INVESTIGATIONS OF THE ROYAL INSTITUTE OF Biological Sciences. An analysis was made of the viabilities of populations of Drosophila melanogaster. (Also published as AECU-1465.)


X-rays were used to study the effects of new radiation-induced mutations on viability of otherwise homozygous individuals investigated in populations of Drosophila melanogaster, representing a diploid individual. Data are tabulated and results discussed.


An analysis was made of the viability effects of radiation-induced mutations in heterozygous condition in populations of Drosophila. The results of seven large experiments involving the examination of more than 9000 cultures and the counting of more than 8 million flies are summarized in tabular form. Limitations of the experimental procedures and results of the experiments are discussed. (NSA 25: 558, 1965)


The report discusses the results of three new experiments on viability effects of newly induced mutations. Two of these studies deal with Drosophila melanogaster. Males carrying irradiated X-chromosomes have lower viabilities than males with non-irradiated chromosomes. This is true at the levels of 500 r, 1000 r and 2000 r used. Females carrying a single irradiated chromosome are affected only slightly, if at all, by mutations on this chromosome. Results of these and more complex studies are discussed.


Irradiated populations of Drosophila melanogaster were analyzed in order to determine the extent to which induced mutations might modify the adaptive value of populations. Lethals accumulated much more rapidly in the irradiated populations than in the control. Difficulties in interpretation are discussed. The amount of genetic diversity present in a natural population is stressed.


An introductory account is given of experimental populations of Drosophila melanogaster under different conditions of acute and chronic irradiation. Two types of data are given: (1) chromosomal content of the population in terms of lethals, semilethals, and viability modifiers; (2) estimates of the adaptive values of the populations based on viability of random heterozygotes. The discussion treats with the establishment within populations of coordinated genetic systems and the bearing this process has on irradiated populations generally. (BA 28: 58817, 1961)

(Also published as AECU-1447, Long Island Biological Assn., Biological Lab., Cold Spring Harbor, N.Y.)


The fate of x-ray-induced chromosomal abnormalities introduced into a small, semi-isolated population of Drosophila melanogaster was investigated. By the sampling technique used an appreciable number of chromosome abnormalities were detected in the population at a later sampling period. Failure to detect them is related to low reproductive efficiency of the irradiated flies and possible failure of the flies to survive and compete even though reproductive efficiency is not lowered. (from sub. summary)
II APPLICATIONS

II-A: A Sterile Male Technique

II-C: Screwworm Fly


Experiments were carried out on the island of Curacao to test whether an isolated population of Callitroga bimaculata (Cq.) could be eradicated through the release of sterilized flies. 5th-old pupae were sterilized with $\gamma$-radiation and sent to Curacao by air freight. Adults emerged after 2 d irradiation and were released within 24 h. Sterilized flies were collected (ca. 100/square mile/week) and, subsequently, egg masses were collected and examined for hatching. The effect of weather on fly activity and of release rate were tested. Release and observations were continued. They were stopped 8 weeks after the last egg mass had been collected. Eradication was achieved.

An early USDA release on this subject appeared in Amer. J. Ass. Agr. Sci. 22 (1955) 229 briefly reporting the Curacao experiment (see index for detailed articles).


From May 1, 1957 through August 16, 1957 approximately 200 000 sterile screwworms were released per week over a 2000 square-mile area in East Central Florida. The method of sterilization and packaging is discussed along with observations on the effect on the natural screw worm population as determined by egg mass collections and case incidence.


Brief popular outline of damage caused by the pest and measures taken for its control (rearing and distribution of irradiated flies). Illustrated by 15 photographs.


Approximately 500 sterile male screwworm flies Callitroga bimaculata (Cq.) were released weekly per square mile over a 2000-square-mile area in Florida. The insects had been irradiated as pupae, within 3 d of adult emergence, within 6200 to 8300 r gamma rays from Co$^{60}$. They were packaged at the rate of 380 pupae per release carton. Flies were distributed daily in 8-mile swaths by small aircraft. Shifting of-flight lines resulted in the area being covered in 1-mile swaths weekly. Egg-mass collections in the treated area declined from a weekly average of 41 per station during the first 3 months to 11 in the 12th week. Check stations indicated a continuing high population north of the treated area but a decline on the west and south. However, at the end of 3 months 70% of the egg masses were sterile. (auth.)

(See earlier abstract "Mechanical devices for disposal of sterilized screw worm flies from aircraft" in Bull. Soc. Soc. Amer. 3, 3 (1957) 35, abstr. 19.)

* Butterfield 1940 - [1940]

Eradication of insects by release of sterile males exploits the mating behaviour of the male to find and inseminate the female with sterile sperm. Operation of the method and factors essential for success were reviewed in relation to the eradication of screw-worm fly (Callosobruchus maculatus) and its possible application to Australian sheep blowfly (Lucilia cuprina). The biology and ecology of the two species are compared. The effects of radiation are considered in relation to emergence, deformity, longevity, mating behaviour and sterility. (auth.)

Bushland and Hopkins 1948 - [1111]


An experiment was conducted on the island of Curaçao, which is beyond the flight range of screw-worms (Callosobruchus maculatus (Curt.)). Sterilized flies were reared from the area at the rate of 165 males per square mile for half the island, and the other half at about 400 per square mile each week. The lower release rate caused approximately 31% sterility of egg masses, and the higher rate 49%. The egg masses were checked in wounded goat pens kept all over the island, which ultimately indicated that the screw-worm had been eradicated.


An account is given of the background work which led to the eradication of the screw-worm fly, Callosobruchus maculatus (Curt.), after extensive laboratory and field tests. The gamma-ray source is described. An isolated area was essential for effective control. Data on egg masses in 11 goat pens during the release of sterilized flies over the entire island of Curaçao are given over the test period in terms of the number of males released per square mile and the percentage of sterile egg masses observed. Possible applications of the method elsewhere and on other insects are discussed.


Radiation may affect insect populations in three ways: 1. Massive doses sufficient to cause degeneration of cells and loss of function in vital somatic tissues are lethal. The practical application of gamma-rays to destroy insects infesting stored products is now under consideration. This use of radiation is analogous to such an application in fumigation for insect control. 2. The gonads of adult insects are much more susceptible to radiation than are somatic tissues. Insects are sterilized by doses that do not kill them. The release of sterilized males to compete for mates with those of a natural population is a form of biological control now being tested on screw-worms (Callosobruchus maculatus (Curt.).) 3. Amounts of irradiation less than the sterilizing dose cause recessive lethal mutations which when recombined in succeeding generations are fatal to homozygous individuals. However, natural selection operates to eliminate recessive lethal mutations, and in the mean cosmic heterozygous individuals may display hybrid vigor. Therefore, the introduction of harmful recessive mutations in a population as a form of biological control analogous to disease introduction should not have the promise of lethal or sterilizing radiation. (auth.)

Bushland, R. C. INSECT ERADICATION BY MEANS OF STERILIZED MALES. Plants and Gen 16 (1960) 88-94.

General review (popular) of the scientific principles involved, illustrated by the fate of the screw-worm fly in the southeastern United States.


Review article. The principles employed are discussed. Screw-worms were thus eradicated from Curacao in 1954 by 4 months of release. Possible further applications and related research in progress are discussed.

A very comprehensive survey is given of the whole problem of controlling insects by this technique, including basic questions (type of radiation, dosage, stage of development at irradiation, effects of insect sterilization. The screwworm problem is reviewed, with a chronological account of the sterilization experiments and cytological studies, and studies on mating habits. These led to the mass production of sterilized flies and to the ultimate eradication of the pest in Caracas. The use of sterilized males for the control of other insects is discussed (fruit fly, mosquito, cootling moth, etc.). In many cases previous treatment with insecticide would enhance the effectiveness of the sterile-male technique. It is essential to know not only at what stage mating occurs in various species, and how frequently each sex copulates but also details of spermatogenesis and oogenesis as they relate to establishing the time for a sterilizing dose of γ-rays.


After discussing the biology and geographical distribution of the screwworm the author describes conditions of laboratory rearing. The origin of the theory of releasing sterilized males for screwworm eradication is traced and the genetic basis for irradiation sterilization. After some field trial in Florida the eradication campaign in Caracas was started and completed successfully. Techniques for mass rearing, sterilizing and distributing the flies are described. Insecticides for screwworm control are also applied (fumigations, sprays and dusts). Screwworm eradication programmes in the southeast of the USA are discussed.


Screwworm (Callitroga hominivorax) (Cpl.) larvae were reared in sufficient numbers to produce 2 million sterilized flies weekly for 20 consecutive weeks at a Florida field test. Five eggs each week were obtained from 50 colony cages, each stocked with 100 2-d-old flies, by keeping an attractive medium in the cages. Single cultures of 100,000 larvae were reared on a mixture of ground lean meat, blood, and water, in vats. Until irradiation as 6-d-old pupae, the insects were held at 89°F and 96% per cent relative humidity.

(Revised earlier, see Bull. ent. Soc. Amer. 3, 3 (1957) 32, abstr. 18.)


Details of the irradiation (γ from Co60), irradiation procedure (exposure of pupae 2 d before emergence), fly factory capacity (maximum 100 million flies/week). Layout of safety precautions, operational procedure, value and cost of such an eradication programme are discussed. Other programmes (e.g., Belgian work on the tsetse fly, and work at Hawaii on several fruit flies) are mentioned.


A number of key factors must be considered and resolved before the procedure can be regarded as feasible for eradication or controlling any given pest. 1. A method of mass mating of the insect must be available. 2. Adequate dispersion of the released sterile males must be obtained. 3. The sterilization procedure must not adversely affect the mating behaviour of the males. 4. The female of the insect to be controlled must normally mate only once, or if more frequent matings occur the sperms from γ-irradiated males must compete with those from fertile males. 5. The population density of the insect must be inherently low or the population must be reduced by other means to a level which will make it economically feasible to release a dominant population of sterile males over an extended period of time. Research to develop ways to induce sterility instead of death among field populations of pest species and the advantage of this approach over lethal methods is stressed. (from such summary)


This article is an account of the research that has led to this unique method of insect control, based on an understanding of the life history, habits, and population dynamics of the screwworm fly, together with knowledge of the effects of atomic irradiation on genetic material of insects.

(See also TID-10984(145), Technical Information Service, ABC, 1960, 93 p)

1492 Knipping, F. E. SCREW-WORM MALE METHOD. Smithsonian General review of the field. 1963


The principle of the method a dominant population of sterile animals beyond the already is pointed out. The stere type-male technique does not interfere with the natural population of sterile males, application for undesirable 1.


Callitroga hominivorax (Callitroga hominivorax Cpl.)

1495 Knipping, F. E. THE ERL A review of the problem of insect control at the time of the development of sexually sterile males. Mill exposure to high-energy 1c and release requirements may modifies their reproductive result. The advantages of 1 strive for particular species 5 as it can to sexicides 1c in contrast to other killing other pests are discussed, not distribution.

1496 Knipping, F. E. USE OF D Review article, in canidule fuller understanding of the population from one species required to hold insects to a level mortality is not can in time lead to a larger local population, rather the species to destroy 15 to 20 km, the use of chemicals to attack and containing the new release of insect larvae that


The screwworm, Callitroga conducted by the flavomale with sterile females, and t

General review of the field and of the large-scale application of radiation effects to Callitropsis hominivorax.


The principle of the method, involved in control or elimination of an insect species through the release of a dominant population of sexually sterile males is discussed. Further possibilities for other species and animals beyond the already successful eradication of Callitropsis hominivorax (achieved by the 4th generation) are pointed out. Theoretical population trends are considered in tabulated form and the effectiveness of the sterile-male technique discussed for various cases. The advantage of inducing sexual sterility in a natural population by chemical or other treatments over the method of rearing and releasing a dominating population of sterile males are considered. It is suggested that the sterile-male method may have practical application for undesirable populations of certain wild animals as well as for insects.


Callitropsis hominivorax. (See other publications by Knipling on same subject)

Knipling, 1968 - [1944]


The author reviews problems caused by this destructive parasite of livestock. The ecology and characteristics of the pest are described, and some of the preliminary studies which precipitated the large-scale application of sterile males. Millions of flies were reared in a screwworm factory, and made sexually sterile by exposure to high-energy radiation. Sanctional release over the infected areas followed (details of rearing and release requirements are given). The sterile males, mating with females in the natural population, nullified their reproductive capacity. The complete elimination of the natural population was the ultimate result. The advantages of the method are its selectivity (not involving the general ecological system outside the particular species being sterilized), the fact that no species can acquire immunity to sterile mating as it can to insecticides; and the increasing efficiency of the method as the remaining population decreases, in contrast to other killing agents where efficiency goes down at this stage. Applications of the method to other pests are discussed, together with the limitations inherent in certain species and their geographical distribution.


Review article. In considering ways of controlling or eradicate insects, the importance of a fuller understanding of the population density in an area is stressed. Knowledge of the rate of increase of population from one generation to the next is basic to an understanding of the degree of control that is required to hold insects to non-economic levels. Theoretical calculations are presented to show that a low level mortality that is constant and superimposed on mortality produced by normal environmental resistance can in time lead to a greatly reduced population. The importance of applying control measures against the total population, rather than against segments of the population is pointed out. Four ways of using an insect species to destroy its own kind are: (1) the release of insects made sexually sterile by gamma radiation, (2) the use of chemicals that produce sexual sterility in the natural population of insects, (3) the release of adults infected with pathogens that would destroy larval perry by transmitting the disease to other adults and contaminating the environment where the insect reproduces and develops, (4) the development and release of insect strains that carry deficient genetic characteristics. (nuth)


The screwworm, Callitropsis hominivorax (Curt.), has a comparatively low natural population. Research conducted by the Entomology Research Branch showed that sterilized males released over small areas in the area of native females, and that the eggs produced were infertile. The release of sterilized males on the
Lindquist, A. W. USE OF SEXUALLY STERILE Males FOR ERADICATION OF SCREW WORMS. p. 229-36 in “Radioisotopes and Radiation in the Life Sciences. 2nd Inter-American Symposium on the Peaceful Application of Nuclear Energy, Buenos Aires 1959”, TID-TID. Washington, D. C., Pan American Union, 1960. Exploratory experimental work on Callitroga hominivora as control is reviewed. In its life history and its importance as a parasite of swine-blooded animals are discussed, the destructiveness of the screw-worm to livestock being emphasized. Results are reported from experiments in which males were exposed to radiation doses of 2500 to 7500 r before release into the native population. Motile sperm of low viability are produced which impregnate eggs that die soon after penetration by the irradiated, damaged sperm. Since screw-worm females mate only once a reduction in population is seen evident. Results are reported for an immense eradication program covering about 50,000 square miles in Florida.

Smith, C. L. MASS PRODUCTION OF SCREW-WORMS (CALLITROGA HOMINIVORAX) FOR THE ERADICATION PROGRAM IN THE SOUTHEASTERN STATES. J. econ. Ent. 53 (1960) 1100-6. From January 1958 to October 1959 slightly more than 3,75 X 10^8 pupae were produced, utilizing approximately 61 million pounds of horse and white meat, during the screw-worm eradication program conducted in the Southeastern States, by the procedures described. The number of grams of eggs obtained from the store. Apparently the required to meet the weekly fly production in the irradiation program was about 1700 pounds per week and the pupae produced in relation to the number of flies released are shown graphically. (auth.)

II - A - 2 FRUIT FLIES


Christensen, L. D., Steinm, L. F., Balock, J. W., Stone, W. E. APPLICATION OF STERILE FLY RELEASE AND OTHER IRRADIATION TECHNiCLES TO TROPICAL FRUIT FLY CONTROL, ERADICATION AND QUARANTINE PROBLEMS. Bull. ent. Soc. Amer. 3 (1959) 116, abstr. 62. Overflooded normal cage populations of tropical fruit flies with sterile flies greatly suppressed fertility, despite frequent mating. Pilot eradication tests with sterile males on isolated Pacific islands are planned. Irradiation studies with immature fruit flies have suggested quantitative usefulness for an irradiation treatment applied to fresh fruits and vegetables.

Moore, E. THE POSSIBLE USE OF STERILE MALES IN CONTROLLING OR ERADICATING QUEENSLAND FRUIT-FLY. p. 130-7 in “The Technological Use of Radiation, Proceedings of the Conference on the Technological Use of Radiation, Sydney, Australia 24-28 May 1958”, Sydney, Australian Atomic Energy Commission, 1958. The Queensland fruit-fly, Drosophila tryoni, is a destructive pest in Queensland and New South Wales and an expensive potential pest in Victoria and South Australia. Selection at the southern limits of its distribution may yet give rise to a new permanently established race. Methods of mass-rearing have been developed at Sydney University, apparently adaptable to factory conditions. D. tryoni could probably be dropped by aircraft, the pattern of release would depend on fundamental knowledge of the movement and distribution of the flies. The effects of various radiation doses given at different pupal stages on subsequent mating...
behaviour and male longevity are discussed. Matting behaviour of females has, so far, only been studied under laboratory conditions. The areas are discussed where such an eradication programme might be attempted economically. Most evidence to date suggests that D. tsetse is suited to this method but much research still remains to be done, particularly on the ecology. (Discussion: p. 159-7.)

1480


Despite multiple mating and loss of sterility in the oriental fruit fly (Dacus dorsalis Hendel), the Mediterranean fruit fly (Ceratitis capitata Wied.), and the melon fly (Oidipoda californica Coq.), tests of populations containing various ratios of irradiated and normal flies indicated that under laboratory conditions the resultant egg fertility was proportional to the ratio of sterile and normal flies present. The nature of the effect of y-irradiation on fruit flies has not been determined. In addition to the presumed production of a high percentage of dominant lethals in the moths spermatogonia, there appeared to be some reduction in the moth sperm-producing capacity. Despite the unfavorable factors encountered (along with the problem of vastly larger populations to be suppressed, than were encountered in the screwworm experiments) the method has promise of being a useful eradication tool against isolated fruit fly populations.

II-A-3 TSETSE FLY

* Potts 1951 - [1152]
* Potts 1957/58 - [874]

1494


Pupae of Glossina pallidipalpis collected in the field in East Africa were sent to London where they were subjected to gamma irradiation from a Co60 source. Dose varied between $0.1 \times 10^6$ and $3 \times 10^6$ rep. Dissection of samples of pupae at the time of irradiation indicated that 95% were in the middle stages of development (5th-28th of a 27-day pupal period) and 5% were in late stages of development (23-27th of a pupal period). Fertility of females was determined by dissection. As the sexes appeared completely normal after irradiation, fertility of males was gauged by mating with normal females. Male mortality was not increased by doses of irradiation of up to $2 \times 10^6$ rep but there was a decreased emergence at $3 \times 10^6$ rep. The sex of male flies was X-linked but mating ability was not affected. At $3 \times 10^6$ rep 70-200% of males were not sterilized, and at $5 \times 10^6$ and $12 \times 10^6$ rep 10-30% of females remained fertile. (Ba 38: 47228; 1959)

1495


Brief review of the prospects of controlling the species Glossina by means of atomic radiation.

1496


The use of artificially sterilized males has been suggested as a means of controlling tsetse populations. A mathematical model of a natural tsetse fly population is set up, and the theoretical effect of the introduction of sterilized males is examined. Numerical results obtained on an electronic computer are presented and discussed. It appears impractical to attempt the control of a high density tsetse population (~1000 males per sq. mile). Where the density is low, however, (~100/sq. mile), the irradiation method may prove effective, especially when the low density is produced by an insecticidally application immediately before the release of sterilized males. Experimental data show that both sexes are sterilized by y-rays. Females from the irradiated pupae show no ovarian development, and the males produce spermatozoa which fail to fertilize even normal females. The effect is not absolute.
1497 Barczaui. R. NUCLEAR ENERGY FOR CONTROL OF INSECT PESTS. *Rev. Agric.* 93, 11 (1956) 719-77. (in Italian)
Review article.

Review article of wide general interest.

The chapters in this book are based on papers presented at the UN Conference on Peaceful Uses of Atomic Energy held in Geneva, Switzerland, in Aug. 1955. Selection was exercised not only in the individual papers chosen but also in the topics. Topics covered include all the general use of radioisotopes in agriculture (p. 1-29 describe Canadian work, cf. Spinks, 123:75); genetic and biological hazards of nuclear radiation; the genetic eradication of insect pests (p. 281-99, cf. Bushland et al., 123:218); and applications of radiation in food sterilization and preservation.

# Crook et al., 1955 - (1114)

# Davis et al., 1958 - (1136)

1500 Macleod, J. ATOMIC WAR AGAINST AN INSECT: BRITISH TRIALS OF A NEW INSECT CONTROL TECHNIQUE USING GAMMA RAYS TO STERILIZE MALE FLIES. *Chemist and Druggist* 177, 4361 (1955) 4-8.
An attempt was made to eliminate the sheep maggot-fly, *Lucilia sericata*, by the sterile-male technique. The species can be sterilized in the pupal stage by a dosage of γ-rays which does not markedly reduce the virility of the adult fly. In 1955-57 a field test was carried on Holy Island, off the Northumberland coast. On that two square miles of land lying about a mile off-shore, the native population of maggot-flies was estimated to be in the region of one or two thousand only. A population of about 20,000 sterile flies, i.e., about 10,000 males, was established in early July, and maintained by weekly additions until the end of the blow-fly season in early October. The initial liberation in 1957 was of almost 20,000 males, and the population was maintained at over 10,000 males by twice-weekly additions until near the end of September. The consistent poor weather of those two summers prevented assessment of progress during the actual experiment, but tests in early summer of 1958 showed that fertile flies were as common on the island as on the adjacent mainland. The unexpected negative result stresses the need for very careful preliminary study of all possible factors which may enter into play in the field.

# Vannian 1960 - (1154)

II - B Stored Products Infestation and its Detection

II - B - 1 COMMODITIES

Survey articles

# Baker et al., 1954 - (1041)

The possibilities of gamma irradiation of grains for control of insect pests are discussed. Because the cost of radiation treatment increases with the dose, its application to disinfecting grain would make use of the small dose (10,000 rad) for reproductive sterilization.

# Brownell et al., 1964 - (1)

# Brownell et al., 1964 - (1)

# Brownell et al., 1964 - (1)
A NEW INSECT CONTROL.

The sterile male technique, which does not materially reduce the size of the male population, has been tried in the field in the United States. The technique is based on the release of sterile males into a population of female insects. The sterile males mate with the females, but do not produce viable offspring. This results in a reduction of the insect population over time.

Detection

The detection of insect infestations is important for effective control. Various methods have been developed to detect insects, such as traps and chemical detection agents. These methods help in identifying and monitoring the presence of insects, allowing for timely intervention.

STUDYING THE EGGS OF LYCITUS BRUNNEUS.

In the course of a study on the possible use of γ-radiation in the control of wood-boring insects, it was necessary to count a considerable number of Lyctus egg-laying blocks. The technique described here was evolved to provide a quicker method of obtaining data on oviposition by irradiated adults and on the effect of irradiating eggs. Tests were made on unseasoned European oak (Quercus robur L.) sapwood. Venous cut at 150s and 200s proved to be the most suitable thickness. In general, blocks containing 3 or more veneers proved the most suitable.

Review article dealing with the effects of radiation on plants, insects, and, in particular, on wheat and flour. Practical applications are discussed.

Practical applications are discussed.


The vast losses due to insects in a variety of commodities are reviewed. Controls other than chemical are discussed, including various forms of radiation. Radiation exposure is considered as a safe, non-destructive means of ridding many stored products of pest pests. New sources of radiation from particle accelerators and radionuclides are described, and estimates of capacity and cost given for facilities designed to treat stored products.

Kuprinoff, J. DIE MÖGLICHKEITEN DER ANWENDUNG IONISIERENDER STRAHLEN BEI GETREIDE UND GETREIHPRODUKTEN. (Scope of applying ionising radiation to grain and grain products). Getreide 6 (1958) 81-5. (In German)

Review. Various aspects of grain preservation, the application of radiation and its effects on conservation and quality are discussed generally.


A résumé of the reports and discussions at the orientation meeting on Danish research on food preservation by irradiation is presented. The topics discussed included a description of irradiation facilities at Riso.

Baker et al. 1963 - [1260]

Baker et al. 1964 - [1263]

Balock et al. 1956 - [1171]


In the course of a study on the possible use of γ-radiation in the control of wood-boring insects, it was necessary to count a considerable number of Lyctus egg-laying blocks. The technique described here was evolved to provide a quicker method of obtaining data on oviposition by irradiated adults and on the effect of irradiating eggs. Tests were made on unseasoned European oak (Quercus robur L.) sapwood. Venous cut at 150s and 200s proved to be the most suitable thickness. In general, blocks containing 3 or more veneers proved the most suitable.

Brownell et al. 1964 - [1260]

Brownell et al. 1965 - [1263]

Brownell et al. 1967 - [1263]
AND WHEAT PRODUCTS FOR 5, 28, 32.

MANUFACTURING PROPERTIES OF SOFT GRIST MILLING ON THE PHYSICAL, BIOCHEMICAL AND MICROBIAL PROPERTIES OF GRAIN. Mechanically treated and irradiated samples were compared for their physical, chemical and nutritional properties. (3, 42)

BAIN. Internal J. Appl. Radiation

The topic is covered in detail in the references provided. For example, the paper by Kupferstein (1958) discusses the effects of radiation on food preservation, and the paper by Nicholas (1956) presents radiation as a method for controlling plant diseases.


Application of radiation in plant disease control is examined in relation to the potential uses of radiation in agriculture. The most promising areas are discussed, and guidelines for future research are provided.


A review article, divided into various sections dealing with the low-dose treatment of foods with ionizing radiation for different purposes. One section deals with results obtained with different dose levels and sources on insects and their eggs in canning, flour and meat. Running costs of exploiting cooling reactor fuel elements as gamma sources are estimated.

Park et al. 1958. [1515]

1957 Переделовский, А. А., Радков, Л. З., Вейцергер, А. И., Урмисиа, П. М., Перевозкин, Е. С. РАЗВИТИЕ МЕТОДА ВОЛНОВОЙ ПЕРЕМЕННОЙ ЭНЕРГИИ В АКВАТОБУСЕ ВОДЫ С ПОДКЛЮЧЕНИЕМ ЭЛЕКТРОДОВ К ВОДОРОДУ И УГЛЕВОДОРОДАМ. Техникум, ИСК. ИЗУЧЕНИЕ ЭЛЕКТРОДОВ И СВЕЧЕНИЯ ВОДОРОДА. Москва 68 (1958) 10-12.

Proteins and carbohydrates are generally used in combination with vitamins and other nutrients in the preparation of various foods. The use of radiation in the food industry is discussed, focusing on the potential benefits and challenges.

549
In order to control Sitophilus granarius and S. oryzae, the grain was irradiated, using x-ray installations RUM-3 (900 kV, 0.5 mm Cu filters) and RUP-3 (600 kV, 2.0 mm Cu plus 0.25 mm Fe filters). 10,000 r were required, whether x-rays, fast electrons or y-rays were used. For dehulling, fast electron generators and powerful isotope sources of y-radiation resistant suitable sources. Fusion fragments of uranium nuclei represent the most promising sources of y-rays in view of the low cost of these waste materials from atomic industry. A pilot y-installation is being designed at the Institute which should allow the dehulling of grain on production lines.

From Reference Zhurnal Biologii 1: 7082, 1959

Richardson, H. H., Balko, UNDER PLANT QUARANTINE General review article. VI. Irradiation indicates it to be possibly other insects. Cocc reproduction. Work on ma

Shiroi, M., Hayakawa, Y., IONIZING RADIATION IN C ERMATION OF WHEAT 1855. 11, 97-92. (In jap

Tramp, J. G., Proctor, B. I. Sterilization of certain foo been made possible. A Var tation depth. The method is infected by Sitophilus gran

Proctor, R. E., Goldsmith, S (1855) 570-60. The type of radiation needs effects of irradiation on fl on work with cereals infests of radiation processes to ex

Proctor, R. E., Lockhart, E. THE USE OF IONIZING RAI RATIONS. Food Technolog The use of toning radiat processes was investigated, a and y-rays needed to destroy made with cereal and fruit the effects of these radiat irradiation did not adversely characte characteristics of the water sterilization of a typical r (from auth.)


The literature on the action of ionizing radiations on insects (work on grain weevils) and calculations show that technically, economically and biologically it is advisable, in view of pest populations, to use only comparatively small doses (10,000 r) of X- or y-rays, which produce general infertility or fatal damage in the embryonic or post-embryonic development of the progeny of the irradiated parents. The extension of weevils in all stages of development is, furthermore, accelerated, followed irradiation. On irradiation the average food consumption of the dying weevil population falls perceptibly, which favours the use of such a method in combating grain pests. To facilitate dosage calculation, blue prints of a powerful y-radiation installation suitable for pilot-plant testing of irradiation of common grain supplies are being drawn up. Radioactive isotopes of cobalt and caesium, and mixtures of such materials are proposed as sources of radiations.

(See also "Use of ionizing radiation against pests of stored grain," Biophysics 9: 293-315, 1957.


Plans for the layout and tests of the USARC are outlined. A list is given of the foods which, to date, are of the greatest interest for processing during the initial operational phases of the USARC, and are given under fruits and vegetables, meats and poultry, and cereal and baked products. Operation will encompass the comparison of y-radiation and electron treatment. Emphasis is to be placed not only on the sterilizing levels of irradiation, but also on pasteurization, surface treatment, insect de-infection and the inhibition of sprouting in potatoes and other tubers. The linear-accelerator-conveyor complex will consist of a 25-MeV, 18-Mev accelerator and its auxiliary conveyor equipment, and will be the most powerful unit ever to be constructed for irradiation processing.


A review article. The author examines the problems connected with the use of ionizing radiation for the sterilization, pasteurization and decontamination of foods. A total of 224 references is listed.
1821 Proctor, B. E., Goldblith, S. A. FOOD PROCESSING WITH IONIZING RADIATIONS. Food Technol. 6 (1952) 378-89.

The type of radiation necessary to sterilize foods and drugs, the specific inactivation doses of radiations, the effects of irradiation on flavor, colour, texture and nutrients and packaging problems are discussed. Results on work with cereals infested with Tribolium confusum and Sitophilus granarius are given. The adaptation of radiation processes to existing production lines are discussed and illustrated.


The use of ionizing radiations for the control of insect infestation in certain packaged military ration components was investigated, and investigations were made of the doses of high-energy cathode rays, x-rays and γ-rays needed to destroy all parasitic forms of different insect species. Gezephylant seeds were made with cereal and fruit ration bars irradiated at dose levels found necessary for insect destruction, and the effects of these radiations on the functional properties of some packaging materials were studied. This irradiation did not adversely affect the acceptability of the food products or the physical and functional characteristics of the materials in which the foods were packaged. Specifications are given for the radiation sterilization of a typical ration component, and a conservative cost analysis of such a process is made.

(from sub.)


General review article. Various kinds of quarantine treatment for plant products are reviewed. Results from irradiation indicate it to be a promising treatment for fresh fruit and vegetables infested with fruit flies and possibly other insects. Good tolerances were found, well below doses which effectively inhibit fruit fly reproduction. Work on mango, cucumber, cantaloupe, peach, squash and tomato is mentioned.


1825 Trump, J. G., Proctor, B. E. STERILIZING WITH ELECTRONS. Modern Packaging 24 (1952) 105-6, 154.

Sterilization of certain foods and pharmaceuticals by passage through a stream of high-energy electrons has been made possible. A Van de Graaff electrostatic generator is used, the limiting factor being the penetration depth. The method is effective on dry or aqueous media. It is of interest in connection with cereals infested by Sitophilus granarius and Tribolium confusum.

II-8-2 SOURCES FOR DISINFESTATION


A design for an experimental pilot plant for the disinfection of grain by means of Co⁶⁰ γ-irradiation is described. The source consists of a shallow cylinder with 20 rods, totalling an activity of 100 000 g.e.c. spaced along its sides. The plant is provided with protective water shielding. The grain is fed in automatically for irradiation. Co⁶⁰ has been found to be uneconomical for large-scale grain disinfection plants because of its prohibitive cost. It is much more profitable to use the uranium fission products available as atomic industry waste. Due to the low specific activity of the fission products the selection of the most practical geometry of the irradiator requires special care. Cell irradiations were estimated to be the most advantageous. On testing three kinds (cylindrical, rod-shaped and one with a slot) the last was found by the authors to be the most efficient in practice per unit volume of the plant. The efficiency of such an

351
irradiation is 21 tons/h at a net activity of $3.72 	imes 10^8$ c. The relatively low weight of the installation (including water shielding) makes it transportable from one granary to another with ease.


The use of gross fusion products in the preservation of various food stuffs, and the results of tests are described. A 1-year dose of 20,000 r. e. was sufficient to disinfect flour and wheat from insects and this amount of irradiation had no undesirable effects on taste and baking qualities.


The design of a machine to be used for feeding irradiated wheat meal to pullets is given. An extensive discussion of flour irradiation is also given, including the effect of radiation on insects as a possible method of controlling insect infestations in flour. The effect of \( y \)-radiation on the baking quality of wheat, types of facilities for flour irradiation with special emphasis on the use of cooling reactor-fuel elements as a radiation source, methods of radiation dose measurements, and cost estimates of such an irradiation.


After a discussion of the type of insect infestation occurring in cereals, the known effects of ionizing radiations on insects, and of \( y \)-rays on the baking quality of wheat, the author describes one kind of \( y \)-irradiation plant. Activated fuel elements are used as a source. Doses, capacity and economical considerations are discussed. A routine dose of 20,000 r. e. is considered, which provides an adequate safety factor since only 100 r. e. will sterilize the eggs of the confused flour beetle, Tribolium confusum, and the granary weevil, Sitophilus granarius. A bucket conveyor was used to treat 27 tons/h by reactor fuel elements. On the basis of an 8-h shift for 260 d in the year and allowing depreciation over 30 years, the cost of flour irradiation amounts to approximately $5.00 per ton of 100 lb.

For an earlier report, in English, see AECU-9560, 28 pp., 1956, Univ. Michigan, Ann Arbor, Mich.


Grain, flour, and meal irradiation for the control of insect infestation is discussed in the section dealing with the design of facilities (pp. 371-2).


Designs of a semi-mobile facility for treatment of bulk wheat are described. Designers have proposed using Co-60 to administer relatively low doses of radiation (10,000 to 15,000 r) in order to obtain effective control of Tribolium.


The use of fusion-product sources for insect control in grain is described. An example is given of a multiple-unit rod source arranged similar to a vertical tube bundle. Each rod irradiates grain at 0.75 Mrv and a dose of 25,000 r e. at a radial distance of 17.5 cm., about 1 mean-free-path in grain. The net volume of grain irradiated/rod = 377.140 cm.3, exposure time = 1000 h., weight of irradiated grain/rod = 1600 lb.; process rate/rod = 5000 lb/h, giving a utilization efficiency = 14.7%.


A Co-60-irradiation unit is described for insect-infested grain and seed.
SANLAGE ZUR N (The design of a food stuff).  

* TECHNIQUES OF ISOLATING one kind of  
  economical consideration, safety factor, and the grasarry  
  flexibility required for chemical studies. One of the main applications of  
  is in the irradiation of grain and of other agricultural products. (From author summary) 

* Peredolsky et al. 1958 - [1917] 

* Peredolsky et al. 1967 1959 - [1918] 

11-8-3 ECONOMICS 

* Baker et al. 1954 - [1941] (2943) 


In the article "Current status of insect control by radiation" [Science 124 (1956) 1011], Charles G. Hassett gives a table of costs per ton for a 500,000 r dose from various sources in which some of the data appear to be misleading. In particular, I think that the figures given for electron accelerators are a little misrepresented and, in this connection, I would like to call attention to a data given by Wolfgang Huber [Western Canner and Packer (Aug. 1953)]. Huber shows that, for a dose of 90,000 r (approximately 0.58 Megergy) at 50% utilization, machines are available that can treat more than 100 tons per hour at a cost of 40$ per ton or less. I should also like to point out that there appears to be a discrepancy in Hassett's stated cost of the cobalt-60 irradiation units: 10 10 per ton ($5 per pound)." M. C. CROWLEY-MILLING.

The article by Huber, referred to by M.C. Crowley-Milling, appeared after my article had been written and submitted for clearance, hence, it could not be included in my discussion. The data cited actually reinforced my conclusions; that these machines will soon make large-scale radiation economically feasible. With reference to Crowley-Milling's second point, the manuscript submitted to Science shows the correct values: "$10 per ton (5.5$ per pound)." This typographic error unfortunately passed both Science's proof reading and mine. CHARLES C. HASSETT. 

* Hanlan 1953 - [1951] 


The estimates of costs are all related to package radiation equipment. Where possible, the bulk handling of high rates of throughput as, for example, in disinfection of grain, could lead to substantial reductions in cost. The γ-rays from Co60 and Cl36 do not induce radioactivity in any process material.
II-B-4 DETECTION

The use of x-ray equipment to detect infestation of grain is briefly described. (BA 27: 21771, 1956)

An x-ray apparatus was used which operates between 10 and 25 kV. When grain is irradiated healthy kernels may easily be distinguished from infested ones since larvae, pupae or adults can be recognized inside them. Radiographs are shown of wheat infested with Aelurotyne oryzae, Plastina dominica, and Sitotroga cerealella Olliv.

A technique is described for loading individual seed straws with wheat kernels via a small vacuum pump or aspirator. The straw is then passed through a chamber that contains a rotating drum. The drum consists of a wooden cylinder, the internal diameter of which is equal to the length of the straw. A small amount of air is passed through the straw, causing the kernels to become detached from the straw and fall into the drum. The kernels are then subjected to x-radiation, and the resulting radiographs are viewed for the presence of infestations.

1543 Goodhue, R. D., Van Eden, H. F. DETECTION OF STEM BORERS IN CROPS BY X-RAYS. Plant Pathol. 9, 2 (1940) 94.
The x-ray equipment (a Picker-Waite US Army field unit), the tube head of which was mounted to give a vertical film focal spot distance of 38 cm, was used to photograph infested oat plants. To reduce the inherent filtration of the x-ray tube the permanent 0.25 mm aluminium filter was removed. Using Ortho-Kodak sheet film the best exposure factor was 28 kV potential and 39 mAs. (BA 25:35643, 1941)

X-ray examination provides positive identification of hidden insects in grain and more accurate counting of infested kernels than previous methods. (CA 47: 17738, 1953)

Wheat infested with the rice weevil, Sitophilus oryzae, was x-rayed daily to provide a sequence of pictures showing the development of the insect. The technique is useful for studies of the physiology, growth characteristics, and feeding habits of stored grain pests, for determination of the effectiveness of insecticides and fumigants, and for the commercial grading of grain for internal infestation. (auth.)

A radiographic method for the detection of internal insect infestation in grain by means of low energy radiation from a cobalt-target beryllium window x-ray tube is described. The utility of the technique for inspection of wheat, corn, rice and beans is illustrated with cuts made from original radiographs. (BA 26: 11846, 1955)

1547 Miller, M. RECENT DEVELOPMENTS IN X-RAY METHODS FOR THE IDENTIFICATION OF INSECT INFESTATION OF GRAIN. J. econ. Ent. 6, 2 (1955) 99-5.
Recent methods for detecting infestation of stored grain, rendering it unsuitable for use, are reviewed. The x-ray method is described in detail, and the results of its application to various grains and insects are discussed. (BA 26: 11846, 1955)

The examination of infested kernels may be done in a laboratory or on the farm. The x-ray method is described in detail, and the results of its application to various grains and insects are discussed. (BA 26: 11846, 1955)
1547 Milner, M. RECENT DEVELOPMENTS IN METHODS FOR DETECTING INTERNALLY INFESTED WHEAT. Norw. Miller 245, 2 (1951) 12, 16a-18a, 16a-11a.

Recent methods for detecting internally infested wheat generally include the following: the acid fuchsin or iodine stain test, rendering the wheat translucent by boiling in caustic soda, the cracking-flotation test, mass wheat sectioning and examination under ultraviolet light, and the benzene sulfonic stain test. All of these, however, have some disadvantages in that no single one gives a rapid and accurate picture of the condition of the wheat with a single procedure. A recent development is the application of X-ray. X-ray photographs of infested wheat indicate the presence of insects at various stages of development, including even eggs. Also, when the infestation is present in the form of larvae, it is possible to determine if they are dead or alive. This new technique appears to offer possibilities as a rapid test for grading grain on the basis of internal infestation. (BA 27: 21956, 1961)


The Polaroid-Land process has been adapted to X-ray inspection of wheat for internal insect infestation. A completed radiograph is obtained in a few minutes without a darkroom or routine photographic processing techniques. (BA 27: 21958, 1961)

1560 Monte, G.D. GRAIN INFECTIONS AS SHOWN BY X-RAYS. Notizi d’Italia 8 (1958) 422-3. (In Italian)


The examination for total insect damage is time consuming (1-1.5 h for 100 g of wheat) because suspected kernels must be dissected. Dehydrated insects are not visible. Examination limited to the more extensively (grazily) damaged kernels required 6-10 min. The correlation coefficient for grazily damaged kernels compared to the cracking-flotation test was 0.58. In all 378 samples the total X-ray results were 1.5 times that of the cracking-flotation test. (BA 27: 20703, 1961)


Results confirmed that X-ray procedure can be used to measure internal insect infestation of wheat. Various energy levels, and the use of filters were investigated to produce proper degrees of contrast on X-ray film. A satisfactory radiographic of low contrast but with excellent detail can be obtained from an X-ray head with a glass tube, oil bath, and plastic exit ports between target and film at 18 kv and 10 ma. Results with other filters and target tubes are discussed. (BA 27: 20709, 1961)


Internal insect damage as shown by characteristic radiographic shadows can be differentiated for the most part from the characteristic shadows of normal corn structures and the abnormalities of the corn kernel. The grain insect damage visible on the radiograph correlates well with the cracking-flotation results. As compared with previous methods of determining internal insect damage, the X-ray method (a grain inspection X-ray unit, Wrington model 476, was used and technical details are given) is the most rapid for an accurate evaluation of internal insect damage.


X-ray inspection is widely used by commercial cereal grain handlers for mass detection and estimation of infestations. Radiographs made with the X-ray microscope show greater detail and sharpness, and permit the study of individual insects inside the infested grains. It would appear that much more comprehensive studies of the behavior, development and response to environmental conditions are thus possible; X-ray photos are shown of wheat kernels infested with rice weevil. The X-ray microscope used in the study is a General Electric model, with a point source for shadow projection, and electrostatic beam-focusing. A
narrow cone of electrons emerges from the electron gun, enters a condenser lens and is collimated. The collimated beam enters an objective lens which reproduces a reduced image of the electron source at the principal focus of the lens. This reduced electron source produces an equally small x-ray source on the target, a thin tungsten-coated beryllium window. The image is then projected onto a viewing screen or film. Magnification up to 400 x can be obtained; the instrument operates up to 90 K at 100 mA.


Methods used for determining insect contamination in wheat flour depend upon the identification and counting of insect fragments. There is uncertainty regarding the relationship between the extent of insect contamination by fragment count and the mass of contamination present. This was investigated by milling wheat containing 15N-labelled adults of the rice weevil, Sitophilus oryzae. There does not appear to be a high correlation between the number of insect fragments in the flour and the mass of contamination deduced from the level of radioactivity measured.


General Electric Co. developed a special unit for grain inspection. It has a self-contained, high-speed x-ray generator that is operated from a standard 110-V, 60-c output. It is rated at 10-25 kW peak and 8 mA. Controls, sample holder, and film cassette are located at the top of the cabinet (55 in from the floor). A thin beryllium window is used, of sufficiently large diameter to allow a standard 34 x 17 in x-ray film to be practically covered, thus permitting radiographs of a large number of samples with each exposure. Mylar, a high-density plastic, is used for the front of the film cassette and for the sample tray. An industrial, fine-grain film is recommended. Kernels of grain may thus be checked for infestation. The method may be extended to other kernels and seeds.

II - C Sericulture

Artlow et al. 1987 - (1236)


The lethal dose of radiation from a Cs source for silkworm pupae of different species and ages was determined. Smaller doses, not sufficient to cause wholesale destruction of pupae, affect the shape and viability of the moths. The sericin solubility, swelling properties and recovery factor of cocoon treated by gamma rays are better than those of heat-treated cocoon. The colloidal properties are also changed; in particular, the loptic and adhesive properties are increased, which in turn give the raw silk better knitting properties. The killing of cocoon by y-rays has a promising industrial future. The fact that it will probably be feasible under industrial conditions to cut out the costly process of drying the cocoon is of special importance. The effects of irradiation on raw silk, as measured by the dynamonometer properties of the fibre and viscosity in solution are discussed.

Berland 1966 - (814)


Kipiani and Tetradhade 1966 - (1956)

Nako 1956 - (1913)

Smirnov, V. A., Galasova, L. M. DEVELOPING A MULBERRY SILKWORM LINE BY USING RADIATION METHODS IN BREEDING. Vest. Sel'skokhoziss nauki 2, 8 (1957): 142-7. (Russian. Summary in English)

Fisher 1958 - (1212)

Holling, C. S. A RADIOACTIVE SAWFLY PREPARE WITHIN. In the course of work in Ca healthy, parasitized or diseased without being opened was cocoon of Neodiprion sat.
Using radioactive rice

A P.A., Heard, R.E., Mclnerney, R.H. USING RADIOACTIVE RICE

depends upon the identification and control of the extent of insect con- 

The method was investigated by milling the rice and examining the milled rice. The method may be

Applying x-rays to rice, it was noted that some rice varieties were more susceptible to irradiation than others. The study was continued with the aim of improving rice quality through irradiation.


Since male adults produce 20-30% more male than females, successful breeding of sex-labeled races would lead to a 10-15% increase in the number of live males when only males are cultivated. A greater increase in yield of the resulting race would further result from the increased viability of the male compared with the female. An industrial increase of approximately 30-60% may be envisaged. Experimental work is described in which female pupae of the bioluminescent beetle ELASMA (Central Asian Agriculture Research Institute, Moscow) characterized by dark brown coloration were irradiated with x-rays (3000, 2000, 1000, 500 and 1000) at 4.5 x 10^3 rad/min. The moths were then paired with non-irradiated females of breeds with white or dark scales. The hybrid females were again paired with normal males. Ultimately, females developed with and without white or dark scales had a viable hybrid. The viability appears satisfactory and is expected to continue.


1. The technique of preliminary treatment of cocoons is of fundamental importance for the quality of silk thread. The methods now applied to killing of the chrysalis and drying of the cocoons are labour-consuming and to a certain extent deform the membrane of the cocoon, produce a damaged sericin, impair unraveling capacity, reduce the dynamometric properties of the cocoon thread and the yield of raw silk. 2. Investigation of killing the mulberry silkworm chrysalis by X-radiation showed its promise. 3. The average lethal dose for the spring fatsmasted chrysalis was 1500-2000 rep, for the summer one 1000-1500 rep, and for the autumn one 1000-2000 rep. In a chrysalis receiving 30-45% of the lethal dose within the first day of radiation and later doses of 5000 rep the stage of metamorphosis was retarded 10-12 d. 4. The value of the lethal dose depends on the age of the chrysalis; for a one old chrysalis, 10 to 15,000 rep; for an old one, 50,000 rep, and from the eighth day, 1000 to 2000 rep. 5. Tagging of the irradiated parts showed that the dynamometric properties of the silk thread are improved as compared with unirradiated cocoons. The raw silk yield was considerably increased. The irradiated cocoons were well preserved under usual storage conditions.


II - D Miscellaneous Applications

11-D-1 Timber Protection

Fisher 1958 - [1126]


In the course of work in Canada on the reactions of small mammal predators to sawfly cocoons containing healthy, parasitized or diseased pupae, a radiotracer method enabling the cocoons to be classified without being opened was found useful and is described. The radiotracer permitted the detection within cocoons of Neodiprion cerifer (Graff) of Dendrolimus fuciferus (Linn.), larve or pupae of Fasciatus.}

397
In view of the possibility of controlling insect attack in wood by irradiation, the possible effects of radiation on the wood itself are of great importance. A graph is shown where equilibrium moisture content is plotted against relative humidity in an adsorption cycle for control and for irradiated Sitka spruce. It appears that the hygroscopic (and possibly other physical properties) of wood are not only affected by very heavy doses of radiation. The effect is negligible below 10³ rad. Thus, any doses used for controlling wood-boring insects in practice are unlikely to have any significant physical effect on the wood itself.

Zn²⁺ and Ca⁴⁺ have too short a half-life, whereas Co⁶⁰ has a sufficiently long half-life but does not form salts which prove difficult to dissolve. Sn⁶⁰ was used because it has an acceptable half-life and forms barely soluble sulphates. Only paper impregnated with Sn⁶⁰-sulphate solution of 1 mc/em⁴ proved termite-resistant. The insects were dead within 14 d and found to have stored a considerable portion of the radioactivity. If protection should last 66 years then impregnation would have to start with an activity of 8 mc/em⁴, i.e. 8 times the acceptable limit, thus greatly endangering man and warm-blooded animals, particularly in view of the fact that Sn⁶⁰ is stored in the bone.

II-D-2 VARIOUS

---


