1096 Whittinghill, M., Giles, A. R. AN INFLUENCE OF X-RAY INDUCED CROSSING OVER ON THE TRANSMISSION OF LETHAL GENES IN DROSOPHILA (MELANOGASTER). Anat. Record 111 (1951) 465-6, abstr. 49.

1097 Whittinghill, M. CROSSOVER VARIABILITY AND INDUCED CROSSING OVER. J. cell. comp. Physiol. 45 (1955) 189-220, Suppl. 2.

X- and γ-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.

* Wolff and Lindsley 1960 - [1428]

1098 Yanders, A. F. X-RAY-INDUCED CHROMOSOMAL ABERRATIONS OF DOMINANT LETHALS IN DROSOPHILA ROBUSTA. Genetics 37, 5 (1952) 638.

Newly emerged males and females were separated for 10 d prior to treatment of the males with doses of x-rays of 5000, 7500 and 10 000 r units. The percentage of dominant lethals induced in the sperm of the irradiated males was determined by comparisons 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 dissected 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 sperm which has just matured, with a corresponding decrease in viable aberrations, it seems most probable that both the higher values for dominant lethals and the lower ratio 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)

1099 Yanders, A. F. GENETIC EFFECTS OF X-RAYS ON DROSOPHILA ROBUSTA. (abstr.) Neb. Acad. Sci. Proc. 62 (1952) 10.

Newly emerged Drosophila robusta males and females were separated for 10 d, after which the males were treated in groups of 20 to 25 with doses of x-radiation ranging from 5000 to 10 000 r, and placed immediately after irradiation with equal numbers of females. The offspring resulting from eggs laid within 10 d after irradiation were either dissected 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.

1100 Yanders, A. F. THE EFFECTS OF X-RAYS ON THE CHROMOSOMES OF DROSOPHILA ROBUSTA. Nebraska University Abstr. Doctoral Dissertation (1953) 305-10.

1101 Yanders, A. F. X-RAY-INDUCED DOMINANT LETHALS IN DROSOPHILA. Genetics 39 (1954) 558-64.

Drosophila robusta males, aged 10 d or 17 d, were exposed to 0 (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 records 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 dosages. Sperm of males aged 17 d, however, exhibit a greater sensitivity, agreeing with the hypothesis of a greater breakability 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 eggs

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

1102 Yanders, 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 39 (1954) 1002.

Adult males of D. melanogaster (Oregon-R) were exposed to 4500 r of x-rays at 1, 7 or 14 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 Minutes 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 Lüning, Hereditas 38 (1952) 91), suggesting that similar mechanisms are responsible for both dominant lethals and Minutes.

1103 Yanders, A. F. AN INFLUENCE OF AGING MATURE SPERM UPON X-RAYS INDUCTION OF SEX-LINKED RECESSIVE LETHALS. Genetics 41 (1956) 667.

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 4500 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 Minutes 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.

(Abstract of paper presented at the 1956 meetings of the Genetics Society of America, Storrs, Connecticut, 27-29 Aug. 1956)

1104 Yanders, A. F. THE EFFECT OF DOSE RATE ON GENETIC DAMAGE FROM FAST ELECTRONS IN DROSOPHILA SPERM. Radiation Res. 10, 1 (1959) 30-6.

Mature sperm of male Drosophila melanogaster were exposed to 3200 rads of fast (1-6 MeV) electrons from a Van de Graaff accelerator, given at rates ranging from 210 rads/min to 6400 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 17p-report, USNRDL-TR-217, was published in 1958)

1105 Yoshida, Y. H. ON THE GENETIC EFFECTS OF RADIATIONS UPON THE VARIOUS SYSTEMATIC GROUPS IN DROSOPHILA. I. Jap. J. Genet. 32, 8 (1957) 266. (Idengaku Zasshsi) (In Japanese)

1106 Yoshida, Y. H. ON THE GENETIC EFFECTS OF RADIATIONS UPON THE VARIOUS SYSTEMATIC GROUPS IN DROSOPHILA. II. (abstr.) Jap. J. Genet. 33, 9 (1958) 331. (Idengaku Zasshsi) (In Japanese)

I-B-3 INDUCED STERILITY

Books

1107 Demerec, M., ed. BIOLOGY OF THE DROSOPHILA. New York, Wiley. 1950.

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

* Dick 1957 - [4]

1108 Patterson, J. T., Stone, W. S. EVOLUTION IN THE GENUS DROSOPHILA. New York, McMillan. 1952.

Of real interest to workers interested in insect sterilization. Of particular value is the discussion of mating habits, and the reactions which take place in females which only mate once.

* Baker et al. 1953 - [1239], [1240]

* Baker et al. 1954 - [1241]

1109 Baumhover, A. H. INFLUENCE OF AERATION ON RADIATION DOSE REQUIRED TO STERILIZE SCREW-WORM PUPAE. Bull. ent. Soc. Amer. 5, 3 (1959) 129, abstr. 171.

Previous work showed need for increasing dose level as pupae develop. Tests reported here show that dose level (Co^{60}), as it affects degree of sterilization, is independent of pupal age when aeration is provided. Increase in dose level required without aeration closely parallels increase in respiration rate.

* Bletchly and Fisher 1957 - [1245]

1110 Bushland, R. C., Hopkins, D. E. EXPERIMENTS WITH SCREW-WORM FLIES STERILIZED BY X-RAYS. J. econ. Ent. 44, 5 (1951) 725-31.

Callitroga americana males were sterilized by irradiating young adult flies, but it was most efficient to irradiate pupae within 2 d of emergence with a dosage of 2500 r of direct irradiation plus an additional 50% due to backscatter and secondary irradiation. A dosage of 5000 r direct irradiation was required to sterilize females, and that treatment also rendered the females incapable of producing normal egg masses. When sterilized males were confined with normal males and normal females in laboratory cages, most of the normal females did not become fertilized if the sterilized males outnumbered the normal males by a ratio of 5 or 10 to 1. Adding sterilized females to the caged population along with sterilized males did not affect the end result. Laboratory observations showed that male flies will mate as many as 11 times if virgin females are available. Most females mated only once although mated females remained attractive to males. (auth. RCB)

1111 Bushland, R. C., Hopkins, D. E. STERILIZATION OF SCREW-WORM FLIES WITH X-RAYS AND GAMMA-RAYS. J. econ. Ent. 46, 4 (1953) 648-56.

Experiments were aimed at developing procedures for sterilizing large numbers of screwworm flies, Callitroga hominivorax (Coq.). Irradiation effects of x-rays and γ-rays were tested, and the effects of different doses of γ-rays on fly emergence, adult longevity, fecundity and fertility when pupae were treated at different ages. Observations on the hatching of eggs obtained from normal females mated to irradiated males showed that male pupae treated on the 6th and 7th d were not as easily sterilized as were younger pupae. Females showed a similar response in so far as fertility was concerned. It was indicated that no dose of less than 5000 r could be depended upon to produce total sterility, and that it was best to sterilize pupae after they had completed 5 d of development. When normal and sterilized screwworm flies were caged together, the γ-irradiated males competed for mates about equally with the normal males. (from auth. summary)

* Bushland et al. 1956 - [1472]

* Bushland 1960 - [1474], [1476], [1477]

1112 Carney, G. C. DIFFERENTIAL RESPONSE OF MALE AND FEMALE ADULTS OF TROGODERMA GRANARIUM EVERTS TOWARDS STERILIZING DOSES OF GAMMA RADIATION. Nature 183 (1959) 338-9.

Adults of Trogoderma granarium Everts were irradiated with sterilizing doses of γ-radiation (administered from a Co^{60} source at 570 r/min) to study the differential response of the male and female. Results show that a dose of 5×10^3 rads is sufficient to sterilize only the females of the species. The males are able to retain some fertility at dosages up to 15×10^3 rads which is three times that required to sterilize the females. (NSA 13: 7433, 1959)

1113 Cornwell, P. B., Crook, L. J., Bull, J. O. LETHAL AND STERILIZING EFFECTS OF GAMMA RADIATION ON INSECTS INFESTING COMMODITIES. Nature 179 (1957) 670-2.

The effects of γ-radiation on insects infesting cereal commodities were investigated. Tests were carried out on insects of 17 species, and a Co^{60} source that provided a dose-rate of 6000 r/h was used. The effects of different dosages on adults, larvae and pupae is discussed in terms of mortality, development and fertility. A high level of sterility was obtained at 6000 r.

* Cornwell and Morris 1959 - [889], [890]

* Cornwell and Morris 1960 - [891]

1114 Crook, L. J., Bull, J. O., Cornwell, P. B. SOME BIOLOGICAL AND ECOLOGICAL STUDIES ON THE FLOUR-MILL MOTH, ANAGASTA (EPHESTIA) KÜHNIELLA ZELL., FOR AN APPRAISAL OF STERILE MALE RELEASE. AERE R. 3297, Atomic Energy Research Establishment, Harwell, Berks, England. 1960.

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

1115 Davich, T. B., Lindquist, D. A. EFFECT OF GAMMA IRRADIATION ON THE BOLL WEEVIL. Bull. ent. Soc. Amer. 5, 3 (1959) 142, abstr. 280.

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

1116 Davis, A. N., Gahan, H. B., Weidhaas, D. E., Smith, C. N. EXPLORATORY STUDIES ON GAMMA RADIATION FOR THE STERILIZATION AND CONTROL OF ANOPHELES QUADRIMACULATUS. J. econ. ent. 52, 5 (1959) 868-70.

In the laboratory studies on the effect of gamma radiation on Anopheles quadrimaculatus Say, it was found that dosages of 8865 to 12 900 r applied in 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 4:1:1 or less, usually no reduction in the total number of viable eggs was produced, but at ratios of 6:1:1 and 10:1:1 there was a reduction of about 80%. The dosages (r) required to cause 50% and 100% mortality in 48 h were: for eggs, 2600 and >11 000; for larvae, 32 000 and 120 000; for pupae, 22 000 and 40 000. (auth.)

(An abstract was published in Bull. ent. Soc. Amer. 4, 3 (1958) 102, abstr. 277 under "Reduction in the reproductive rate of Anopheles quadrimaculatus caused by the presence of irradiated males in a normal population")

* Dent and Amy 1950 - [1276]

1117 Grosch, D. S., Sullivan, R. L. THE QUANTITATIVE ASPECTS OF PERMANENT AND TEMPORARY STERILITY INDUCED IN FEMALE HABROBRACON BY X-RAYS AND β-RADIATION. Radiation Res. 1 (1954) 294-320.

Permanent sterility could be induced in females by feeding above 200 μc P^{32}/g of honey mixture. At values below 200 and down to 175 μc P^{32}/g temporary sterility was induced, starting about the 10th d. Relatively intense x-rays of 2650 r/min induce permanent sterility above about 4800 r. Below such dosages, down to 3300 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 P^{32}. Onset, and number of eggs laid are influenced by starvation. Fractionation and intensity experiments demonstrate that the manner in which ionizations 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.

* Grosch and LaChance 1956 - [401]

* Grosch et al. 1956 - [383]

* Grosch et al. 1957 - [830]

* Grosch 1958 - [1137]

1118 Jaynes, H. A., Godwin, P. A. STERILIZATION OF THE WHITE-PINE WEEVIL WITH GAMMA RADIATION. J. econ. Ent. 50, 4 (1957) 393-5.

In dispersion studies of the white-pine weevil it was contemplated that large numbers of weevils, tagged with an isotope, would be released in the field. Since external tagging with P^{32} does not sterilize the weevils, a simple method of mass sterilization was sought. Adult weevils were exposed to 5000, 10 000, and 20 000 r from a Co^{60} source. Both sexes were sterilized at all radiation levels. Non-irradiated females mated with irradiated males produced infertile eggs. These females produced fertile eggs when normal males were introduced in the culture. It is concluded that if pairing is repeated as frequently under natural conditions as in the laboratory, the release of sterilized males to reduce the population would not be effective. For sterilizing weevils for use in dispersal studies, a dosage of 5000-10 000 r appeared the best, though the diminished feeding and oviposition rates suggested that other activities, such as frequency of flight, might also be affected.

(An abstract of earlier work appeared in Bull. ent. Soc. Amer. 2, 3 (1956) 17, abstr. 26)

* Jefferies and Cornwell 1958 - [1144]

1119 Kaplan, W. D., Tanaka, T., Tanaka, K. THE STERILITY COMPONENT OF X-RAY INDUCED DOMINANT LETHALS IN D. MELANOGASTER. Genetics 41 (1956) 649.

The determination of dominant lethals in D. melanogaster is based upon egg hatchability measurements. Brooding techniques, the mating of treated males to a succession of virgin females, permit the determination of mutation rates in sperm that were successively younger at the time of irradiation. However, there is no direct way in 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 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 thus 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.

(Abstract of paper presented at the 1956 meetings of the Genetics Society of America, Storrs, Connecticut, 27-29 Aug. 1956)

1120 Kaplan, W. D. THE STERILITY COMPONENT OF X-RAY INDUCED DOMINANT LETHALS IN DROSOPHILA MELANOGASTER. p. 142 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

A sample of eggs from each dominant lethal determination was fixed and sectioned and studied for evidence of sperm entrance. It was found that unfertilized 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 2500 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 carried out. 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 (sperm that were spermatocytes 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 Tanaka (Genetics 41 (1956) 649)

1121 Kaufman, G., Wasserman, M. EFFECTS OF IRRADIATION ON THE SCREW-WORM, CALLITROGA HOMINIVORAX (COQ.). p. 246-59 in "Studies in the Genetics of Drosophila", Vol. 9, Wheeler, M. R., ed. Austin, University of Texas, 1957, 316 p.

The dosage was 7500 r x-rays. Insemination studies showed that in the first week after emergence from the pupae cases 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 dosage 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 spermatid 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 recombinations, or chromosome stickiness, or both.

* King 1953 - [389]

* King (undated) - [1145]

* Knipling 1960 - [222]

* LaChance 1955 - [1149]

* LaChance 1959 - [1396]

* MacLeod 1955 - [1500]

* Melville 1958 - [1150]

1122 Mortreuil, M. ACTION STÉRILISANTE DES RAYONS X SUR LE CHARANÇON DU BLÉ. C. R. Soc. Biol., Paris 153 (1959) 1165-6.

Les charançons, Calandra granaria L., âgés de 15 à 30 jours après émergence, sont irradiés à 500 r/min. L'auteur étudie l'influence de doses croissantes (0 - 16 000 r) de rayons x sur la reproduction; l'effet stérilisant n'apparait qu'à partir de 2000 r, la dose minimum désinsectisante se situe vers 16 000 r.

* Nicholas & Wiant 1959 - [1515]

* Potts 1958 - [1494]

* Rohde 1959 - [895]

1123 Румянцев, П.Д., Ратанова, В.Ф. ВЛИЯНИЕ ИОНИЗИРУЮЩИХ ИЗЛУЧЕНИЙ НА ХЛЕБНЫХ КЛЕЩЕЙ. Труды всес. н.-и. ин-та зерна и продуктов его переработки, Москва 35 (1958) 55-7.

Действие рентгеновых лучей в дозах 5 - 300 тыс. р испытывали в 10 сериях опытов на удлиненном клеще. От облучения в дозе 5 тыс. р погибло 84% яиц, большей частью более молодых (1 - 3-дневных). Половая стерилизация личинок, нимф и взрослых клещей достигалась облучением в дозе 60 - 80 тыс. р. Дозы 300 тыс. р вызывали гибель всех стадий клеща в течение 2 недель. Удлиненный клещ в 20 - 30 раз устойчивее других вредителей хлебных запасов к действию ионизирующих излучений. Дозы облучения < 100 тыс. р снижают посевные качества зерна и применимы лишь для обеззараживания продовольственных хлебных запасов.

Rumyantsev, P. D., Ratanova, V. F. EFFECT OF IONIZING RADIATION ON GRAIN MITES. Trudy vses. n.-i. in-ta zerna i produktov ego pererabotki (Trans. All-Un. sci Res. Inst. Grains and Products of Processed Grain) 35 (1958) 55-7.

The action of x-rays (for doses from 5000 - 300 000 r) on the elongated mite Tyrophagus noxius was studied in 10 series of tests. An exposure to a dose of 5000 r destroyed 84% of the mostly younger (1 - 3 d old) eggs; 60 000 - 80 000 r resulted in sexual sterilization of larvae, nymphs and adults; at the end of 2 weeks, exposure to 300 000 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 100 000 r have an adverse effect on the sowing quality of seeds and can only be used for the decontamination of cereals stored as food supplies. (from Referativny Zhurnal Biologia 1 (1959) 7081)

* Simpson 1958 - [1496]

1124 Vasilyan, V. V. THE EFFECT OF RADIATION ON THE DEVELOPMENT OF PECTINOPHORA MALVELLA. Rev. ent. URSS 39, 3 (1960) 599-604. (In Russian)

The cotton-infesting Pexicopia (Pectinophora) malvella (Hb.) necessitates internal quarantine measures, and measures are also taken to prevent the introduction of Pectinophora gossypiella (Saund.). Since existing methods of disinfestation are not entirely satisfactory and the two moths have similar habits, x-ray treatment was tested against the former, with a view to the control of either species. Larvae of the overwintering and summer generations of Pexicopia were subjected to various doses of x-rays in petri dishes at 18-20°C. After 1000 r (with filter), the overwintering larvae, treated in their cocoons, showed 65. 5% mortality, the adults emerging reproducing normally; 5000 r gave a 91. 3% kill with, and 84. 5% kill without filter. Emerging adults were abnormal. Mortality after 10 000 r and 15 000 r was complete (or nearly), with or without filter. Mortality of untreated insects was 23 - 33%. Some of the individuals of the summer generation were irradiated in the last larval instar, and the remainder 2 - 3 d after pupation, 1000 r and higher doses being used. The results are discussed. When a few adults of the summer generation were treated, 1000 r did not affect fecundity, 5000 r led to complete sterility (with filter). Without filter, ovipositing was reduced to 30. 8% and the number of eggs laid to 74%; 15 000 r were required for complete sterilization. Radiation did not affect longevity of adults. (from Rev. Appl. ent. A50 (1962) 113)

I - C Effects on Development

I-C-1 SURVEY ARTICLES

1125 Boell, E. J. THE EFFECTS OF RADIATIONS ON RESPIRATORY METABOLISM. J. cell. comp. Physiol. 39, suppl. 2 (1952) 19-42.

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 respiration of grasshopper eggs and embryos during diapause are tabulated, also the respiration of developing eggs exposed to different environmental temperatures after irradiation. Table 3 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-rayed diapause embryos in the presence of 2×10^{-4}M and 5×10^{-4}M 3, 5-dinitro-o-cresol 5 and 12 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)

1126 Fisher, R. C. CURRENT PROBLEMS IN WOODWORM CONTROL. A SURVEY OF RECENT DEVELOPMENTS. Ann. appl. Biol. 46, 1 (1958) 111-7.

This paper was presented at a symposium of the Assoc. of Applied Biologists. The main insects considered were Lyctus 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 treatments, the last in a still experimental stage. Insects in different stages of development, and infested samples of wood were exposed to γ-rays from a Co^{60}-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.

1127 Fritz-Niggli, H. STRAHLENBIOLOGIE, GRUNDLAGEN UND ERGEBNISSE (Radiobiology, Basis and Conclusions). Stuttgart, Georg Thieme Verlag, 1959, 390 p. (In German)

Textbook. Section 3 of part VI deals with radiation effects on insect embryos, taking Drosophila as example (p. 206-18). 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, pupae reactions to irradiation including radiosensitivity and its variation with stage in development, and radiation-induced phaenocopies. Over 1000 references.

1128 Kraybill, H. F. THE EFFECT OF IONIZING RADIATION ON INSECTS. Intern. J. appl. Radiation and Isotopes 6 (1959) 187.

The use of ionizing radiation usually required 25 000 - 50 000 rads to destroy insect eggs; 300 000 - 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 on wheat, flour, oats and spices are described. The species studied were the confused flour beetle (Tribolium confusum), the yellow mealworm (Tenebrio molitor (L.)), the saw-toothed grain beetle (Oryzaephilus surinamensis (L.)), the lesser grain borer (Rhizopertha dominica (F.)), and the cigarette beetle (Lasioderma serricorne (F.)).

* Peredelsky et al. (1957) 1959 - [1518]

1129 Stephens, S., Boche, R. D. ANNOTATED BIBLIOGRAPHY IN RADIOBIOLOGY. ANL-5111, Argonne National Lab., Lemont, Ill. 1953, 367 p.

This bibliography contains 2153 abstracts covering all phases of the biological effects of radiation. Abstracts are arranged in sections covering general information, effects of external radiation, effects of internal radiation and metabolism and toxicology of internally deposited radioelements, radiation sickness, mechanisms of radiation effects and effects of radiation on growth and development, genetics, and cytology. Numerous early references, relevant to the present bibliography, are included.

1130 Wood, T. H. CELLULAR RADIOBIOLOGY. Ann. Rev. Nuclear Sci. 8 (1958) 343-86.

Review article on radiobiology. Some reference is made to work on insects (Drosophila, Habrobracon). 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 modifiable 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, nucleic acid synthesis and growth, mutagenic, biochemical and miscellaneous effects), and with some aspects of cellular radiobiology, such as mathematical radiobiology, target theory, etc.

1131 Yeomans, A. H. RADIANT ENERGY AND INSECTS. p. 411-21 in "Yearbook of Agriculture 1952". Washington, D. C., US Government Printing Office.

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

I-C-2 FECUNDITY

1132 Annan, M. E. EFFECTS OF X-RAYS ON THE FECUNDITY OF INDIVIDUAL DROSOPHILA FEMALES. (abstr.) Neb. Acad. Sci. Proc. 62 (1952) 10.

Since it 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 dosages would not yield appreciable results and that the observations should be limited to the number of eggs laid. The results suggest that the 2000 r treatment, as compared with untreated controls, did not produce a striking effect. The 5000 r treatment, however, seemed to reduce the fecundity of the females appreciably. (from abstr.)

1133 Annan, M. E. THE EFFECTS OF X-RAYS ON THE FECUNDITY AND FERTILITY OF DROSOPHILA ROBUSTA FEMALES. Diss. Abstr. 14, 8 (1954) 1130.

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 (controls), 2500 and 5000 r of x-rays were used. Treating females with 5000 r considerably reduced fertility, even sterilizing many of them. The reduction of 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-d period of observation only. From then on, variable recovery was exhibited.

1134 Annan, M. E. EFFECTS OF X-RAYS ON DROSOPHILA ROBUSTA FEMALES. (abstr.) Genetics 39 (1954) 957.

Groups of ten virgin D. robusta females, 10 or 17 d old, were either exposed to x-rays (2500 or 5000 r units) or served as untreated controls. Immediately after treatment each female was placed in a vial with two males. For 10 d 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 2500 r, the reduction was less than 1/2 as great as in the 5000 r treated series. Dissection of the females on the 21st d showed the ovaries of those females which had been exposed to 5000 r x-rays to be considerably atrophied. 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 of egg-hatch by x-rays was nearly proportional to the dose for the first 10 d 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 Yanders (1954) in his study of D. robusta males. Whereas Yanders found a greater induction 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.

1135 Bertzbach, R. EXPERIMENTALE UNTERSUCHUNGEN ÜBER DEN EINFLUSS VON RÖNTGENSTRAHLEN AUF DIE EMBRYONALENTWICKLUNG DER HONIGBIENE (Study on the effect of x-rays on the embryonic development in the honey bee). Roux Arch. EntwMech. Organ. 152, 4 (1960) 524-51. (In German)

1136 Colombo, G. X-RAY INDUCED IMPAIRMENT OF FECUNDITY AND FERTILITY OF BOMBYX MORI FEMALES. p. 57 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

Females of the silkworm Bombyx mori L. lay all their eggs at one time, and the steps of egg maturation are rather strictly related to the developmental stages. Females, as well as males, were irradiated by x-rays (Therapeutic Philips Apparatus, 50 kV, 2 mA, 950 r/min) at 3rd and 5th larval stage and early and late pupae with 1000 r, 2000 r, 4000 r and some with 8000 r, by varying the length of exposure. The irradiated females were crossed with untreated males of the same egg-brood, the males with untreated females of another egg-brood of the same race. The number of laid eggs (fecundity) and that of hatched larvae (fertility) were recorded. Above 2000 r fecundity 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 oöcytes is higher during the 2nd period of growth than during vitellogenesis. Fertility, which can be considered a test for induced dominant lethals, is more affected in later stages of oögenesis than in earlier ones, which means that metaphase chromosomes are more sensitive than prophasic ones. These results are in agreement with those obtained in Drosophila. A stage of oöcyte 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 oöcytes. X-ray treatment probably interferes with RNA production and/or RNA utilization. (from abstr.)

1137 Grosch, D. S. THE QUANTITATIVE ALTERATIONS IN HABROBRACON FECUNDITY INDUCED BY Co^{60} EXPOSURES. Radiation Res. 9 (1958) 123-4.

For γ-ray exposure, wasps held in gelatin capsules were lowered into a repeatable position within a concentric arrangement of radiocobalt needles. One facility delivered 3000 r/h. the other delivered 140 r/h. Graded doses from the former demonstrated that 11 000 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, 13 700 r had to be delivered to obtain the result desired. This latter source has been followed for four years. Increasingly longer exposures have been necessary to halt egg production with the γ-source weakening through decay, provided the temperature during exposure was above 20°C. On the other hand, if exposures were made at 5°C the sterilizing dose was, and has remained, about 11 000 r. This is a temperature low enough to slow down enzyme controlled life processes to a degree that renders them ineffective. Thus recovery processes involving biosynthesis can not take place. Evidence from other types of experiments implicate a chromosomal rejoining mechanism. The restoration mechanism also enters the picture when other radiations are used in combination with γ-rays, as was demonstrated by additivity experiments

involving β-rays from ingested P^{32}. Combinations of 25/75, 50/50, and 75/25, set up from the definitive dose approach, did not prove additive in halting Habrobracon egg production.

1138 Grosch, D. S. WASP EGG PRODUCTION AND HATCHABILITY AFTER THE MOTHERS HAVE BEEN EXPOSED TO MIXTURES OF RADIATIONS. Atompraxis 5 (1959) 290-2.

Definitive doses of a combination of x- and β-rays and of γ- and β-rays are not additive in the induction of permanent cessation of insect egg production. Also, hatchability, used in further assessment of radiation damage, reflects predominance of one component. Recommendations for radiation pest or parasite 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 Grosch, D. S. PROTECTIVE EFFECTS ON FECUNDITY AND FERTILITY FROM FEEDING CYSTEINE AND GLUTATHIONE TO HABROBRACON FEMALES BEFORE X-IRRADIATION. Radiation Res. 12 (1960) 146-54.

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 d after treatment, was therefore limited to cells in transition from oögonia to differentiated trophocyte-oöcyte 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 deferred until the crises of embryonic development implies alteration in the genetic rather than the kinetic mechanism. Indeed, both the effects on oviposition and egg hatchability could trace back to modifications of chromosomal damage, immediate and delayed. (auth. summary)

1140 Herskowitz, I. H. INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. III. THE EFFECT OF MATERNAL DEHYDRATION ON OVIPOSITION RATE AND MORTALITY OF X-RAYED OÖCYTES. Genetics 42 (1957) 289-98.

The mortality in oöcytes 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.

1141 Howden, H. F. INVESTIGATIONS ON STERILITY AND DEFORMITIES OF ONTHOPHAGUS (COLEOPTERA, SCARABAEIDAE) INDUCED BY GAMMA RADIATION. Ann. ent. Soc. Amer. 50, 1 (1957) 1-9.

The biology of O. texanus is given, and the effects of γ-radiation on both the adults and larvae are discussed. There was no reproduction when 2nd instars were irradiated with doses of 2000 r or greater. A dose of 4000 r to 2nd instars 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.)

1142 Ives, P. T. THE EFFECTS OF γ-RAYS ON FECUNDITY AND MUTAGENESIS IN OREGON-R MALES OF DROSOPHILA. Intern. J. Radiation Biol. 2, 1 (1960) 54-67.

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 crossing-over after exposure to cobalt-60 γ in the 100 r to 10 kr range. Tests totalled 42 184 X-chromosomes and 210 111 flies. Mutations were most frequent after irradiation during meiosis and spermiogenesis in low doses. Only sperm and gonial cells subsequently produced adult flies after exposure to 5 kr and 10 kr. 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 combine to influence 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.)

1143 Ives, P. T., Richman, M. W. THE EFFECT OF Co^{60} γ-RADIATION ON THE FECUNDITY OF DROSOPHILA MALES. Radiation Res. 9 (1958) 133.

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 nongenetic and (3) that it occurs, after low

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.)

1144 Jefferies, D. J., Cornwell, P. B. LETHAL AND STERILIZING EFFECTS OF SINGLE AND FRACTIONATED DOSES OF GAMMA RADIATION ON CALANDRA GRANARIA L. Nature 182 (1958) 402-3.

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 rep were given, when larvae grew into very few adults, or 5 fractions of 802 rep each at 1 min to 10 min intervals. Intervals of up to 5 d were tested. The existence of a recovery process, and effects on the production of progeny are discussed. The efficiency of direct irradiation of infested 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.

1145 King, R. C. STERILITY AND RECESSIVE LETHAL MUTATION FOLLOWING X-IRRADIATION OF FEMALE DROSOPHILA MELANOGASTER. BNL-1198, Brookhaven National Lab., Upton, N. Y. 14 p.

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 60% of the initial frequency in eggs laid 7 to 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 fecundity and/or fertility of irradiated females is greatly reduced for the first four 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 polyploid tissue. (auth.)

1146 Kishin, A. F. E. THE RESPONSE OF THE IMMATURE TESTIS OF DROSOPHILA TO THE MUTAGENIC ACTION OF X-RAYS. Z. indukt. Abstamm. -VererbLehre 87 (1955) 97-112.

D. melanogaster males were irradiated at various stages of pre-imaginal development, and mutation rates were compared between first broods of different age groups, and between successive broods in the same age group. The findings were correlated with observations on germ cell development in the larval and pupal testis. Sensitivity to the mutagenic effect of x-rays is low in all premeiotic 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 here about 4 times as high as in mature sperm and about 1½ times as high as during meiosis. Subsequently, mutation rate drops again gradually to the level characteristic for mature sperm. Germinal 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)

1147 Kogure, M., Nakajima, M. DIFFERENT RADIATION SENSIBILITY OF SILKWORM TESTIS TO THE FALL OF EGG HATCHABILITY, WITH SPECIAL REFERENCE TO CYTOLOGICAL AND BIOMETRICAL EVIDENCE. p. 473-80 in "Proceedings of the 2nd Japan Conference on Radioisotopes, 1956". Tokyo, Japan Atomic Industrial Forum, Inc. 1958. (In Japanese*)

Male silkworms were fed with $Na_2HP^{32}O_4$, and the percentage of infertile eggs resulting from subsequent matings was determined. Exposure of 5th instar larvae to 3000 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 5th instar. A predominance of anuclear spermatozoa below a certain level is considered to be responsible for infertile eggs. Abnormalities in metaphase chromosomes also appeared to have some bearings 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. 1295-1312 of AEC-tr-4482)

of the genital organs, and the effects of irradiation on nucleic acid content investigated biochemically. Autoradiography was used throughout.

1148 Kogure, M., Nakajima, M. DIFFERENTIAL RADIOSENSITIVITY OF SILKWORM TESTIS FOR DECLINE OF EGG HATCHABILITY, WITH SPECIAL REFERENCE TO CYTOLOGICAL AND BIOCHEMICAL EVIDENCE. 2nd UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 15/P/1344. 22 (1958) 351-9.

Male silkworms were subjected to 3000 r of γ-rays from a Co^{60} source at the beginning of the (2nd), middle (5th) and end (8th day) of the 5th instar. The percentages of unfertilized eggs and of dominant lethal eggs induced by γ-rays were determined. Biochemical and histocytological studies of the irradiated testis, with special reference to nucleic acid metabolism were also carried out. In other experiments, P^{32} was made available as a tracer by administering $Na_2HP^{32}O_4$. Phosphorus specific activities in DNA and RNA could be measured by using $Na_2HP^{32}O_4$ as a precursor. The rate of occurrence of unfertilized eggs and dominant lethal eggs was found to be dependent on radiation sensitivity in the different stages of spermatogenesis. The mechanisms responsible for these phenomena are discussed.

1149 LaChance, L. EFFECTS OF DELAYED OVIPOSITION ON X-RAY-INDUCED STERILITY. Nucleonics 13, 4 (1955) 49-50.

The effect of delaying the period of observation on induced sterility was investigated from irradiation studies on the parasitic wasp Habrobracon. Egg production curves are given for groups having oviposition delayed for various times after irradiation, all having received 3750 r x-rays expected to produce temporary 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 1-8 post-irradiation) indicate that retention (ovipositional delay) favours deposition of fewer non-viable eggs. The hatchability data for days 9-20 suggest that, with retention of eggs, fewer damaged oögonial cells survive differentiation. If egg production begins immediately, more damaged gametes complete the maturation trip down the ovariole and are oviposited. Delay in egg laying therefore affects hatchability during the entire reproduction cycle.

* LaChance 1958 - [1395]

* LaChance 1959 - [1397]

1150 Melville, C. AN APPARENT BENEFICIAL EFFECT OF GAMMA RADIATION ON THE FLOUR MITE. Nature 181 (1958) 1403-4.

A single irradiation at 5×10^3 and also at 10^4 rad γ-radiation resulted in an increase in the number of eggs laid and hatched by the flour mite, Tyroglyphus farinae. In contrast, irradiation at 2×10^4 rad significantly reduced the number of eggs laid and hatched, and a dose of 4×10^4 rad apparently sterilized the population. (NSA 12: 10311, 1958)

1151 Park, T., DeBruyn, P. P. H., Bond, J. A. THE RELATION OF X-IRRADIATION OF THE FECUNDITY AND FERTILITY OF TWO SPECIES OF FLOUR BEETLES. Physiol. Zoöl. 31, 2 (1958) 151-70.

Young adults of two species of flour beetles (Tribolium confusum and T. castaneum) were subjected to 4 initial 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 3 d until the female beetles 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 parental 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 receive x-rays; (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.

1152 Potts, W. H. THE EFFECT OF GAMMA RAYS ON REPRODUCTIVE ORGANS OF FEMALE GLOSSINA MORSITANS WESTW. Trans. R. Soc. trop. Med. Hyg. 51 (1957) 292.

Three slides were exhibited (at a laboratory meeting of the Royal Soc. Trop. Med. Hyg., March 21, 1957) to show the prevention of ovarian development in G. morsitans by irradiation of the pupal stage with γ-rays

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 tsetse flies.

* Potts 1958 - [1494]

1153 Terzian, L. A., Stahler, N. A STUDY OF SOME EFFECTS OF GAMMA RADIATION ON THE ADULTS AND EGGS OF AËDES AEGYPTI. Biol. Bull. 115 (1958) 536-50.

Studies were undertaken to evaluate some of the biological effects produced by γ-radiation in the mosquito, Aëdes aegypti. It has been shown that egg production was reduced either by mating normal females with males which had been exposed 8 or 15 d previously to dosages of about 30 000 r, or by irradiating females with dosages in excess of 2500 r (with no oviposition at 10 000 r). Reduction in egg hatch was proportionate to dosages in excess of 2500 r, applied to either adult males or females, with no eggs hatching at 10 000 r. Egg hatch was less if females had been inseminated prior to exposure than if insemination had occurred after irradiation. It required dosages of 10 000 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 42 h previously. Viable, fertile F_1 progeny could be produced only from females which had been irradiated at dosages less than 5000 r. Eggs were found to be most sensitive to irradiation during the prehatching period, the LD_{50} varying from 800 r to 7500 r, and most resistant when 3 to 5 d old, the LD_{50} ranging from 30 000 r to 75 000 r. Progeny could be reared only from eggs which had been irradiated at dosages 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. (auth.)

(Also published as 13 p-report, NM 52 01 00. 05. 01, Naval Medical Res. Inst. Bethesda, Maryland 16 (1958) 583-96)

I-C-3 GERM CELLS (INCLUDING OÖGENESIS AND SPERMATOGENESIS)

1154 Abrahamson, S., Telfer, J. D. SEX CHROMOSOME LOSS AND TRANSLOCATION FREQUENCIES IN DROSOPHILA MELANOGASTER AFTER X-RAYING SPERM IN MALES OR IN FEMALES. (abstr.) Genetics 39 (1954) 955-6.

Studies are described to test the effect of homogeneity, age, and stage of germ cells on x-ray mutagenesis. 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 inseminations, while the decline shown by the translocation frequency on second day is somewhat doubtful statistically. Mean losses of maternal 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.)

1155 Abrahamson, S., Herskowitz, I. H. THE EFFECT OF X-RAY INTENSITY AND DOSE ON EGG MORTALITY FOLLOWING IRRADIATION OF FEMALE DROSOPHILA. Drosophila Inform. Serv. 29 (1955) 101.

1156 Alexander, M. L., Stone, W. S. RADIATION DAMAGE IN THE DEVELOPING GERM CELLS OF DROSOPHILA VIRILIS. Proc. nat. Acad. Sci., Washington 41, 12 (1955) 1046-57.

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 oögenesis in the female Drosophila has been shown to be similar to that in Sciara and Habrobracon. 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)

1157 Abrahamson, S., Telfer, J. D. THE RELATIVE CONSTANCY OF THE X-RAY INDUCED MUTATION FREQUENCY OF DROSOPHILA MELANOGASTER SPERM IN INSEMINATED FEMALES. Genetics 41, 5 (1956) 677-84.

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 then aged. 2. When sperm discharged from aged versus non-aged males was irradiated in females no significant difference was found in the sex-linked recessive lethal frequencies obtained. Significantly higher mutation frequencies were again obtained, 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]

1158 Abrahamson, S., Herskowitz, I. H. INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. II. OVIPOSITION RATE AND EGG MORTALITY IN RELATION TO INTENSITY AND DOSAGE OF X-RAYS APPLIED TO OÖCYTES. Genetics 42 (1957) 405-20.

Doses up to 2500 r produced no grossly 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 22.5% of all eggs oviposited during the first 5 d after treatment. Parallelism was found between half-translocations and the intensity-dependent component of egg mortality in all comparisons of behaviour which were made, comprising evidence that the latter is largely if not entirely the result of multiple x-ray-induced events. It is postulated that at least part of the intensity-dependent fraction of egg mortality represents dominant lethal mutations which have their basis in two or more independently produced breaks 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]

1159 Alexander, M. L. MUTATION RATES AT SPECIFIC AUTOSOMAL LOCI IN THE MATURE AND IMMATURE GERM CELLS OF DROSOPHILA MELANOGASTER. Genetics 39 (1954) 409-28.

Mutation rates were obtained for 8 specific loci on the third chromosome of D. melanogaster. With a dose of 3000 r of x-radiation, the rates for mature sperm varied from 2.7×10^{-8}/r for the thread locus to 8.75×10^{-8}/r for the peach and ebony loci. The 8 loci gave an average rate of 5.98×10^{-8}/r/locus. Of the 58 x-ray-induced mutations, 20 were viable, 35 were lethal, and 3 were semi-lethal, when homozygous. Spermatogonial cells in larvae 20 to 22 h old were irradiated with 900 r of x-radiation. Single mutant individuals and clusters 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 spermatogonia under test varied from 7 to more than 100. The spermatogonial mutation rate is estimated to be approximately 1.52×10^{-8}/r/locus. Four spermatogonial mutants were viable, 3 lethal and 1 semilethal in the homozygous condition. A lower average mutation rate obtained for spermatogonia than for sperm can be better explained by a differential genetic sensitivity of the 2 stages than by germinal selection. (auth.)

1160 Alexander, M. L., Clayton, F. E., Stone, W. S. THE INDUCTION OF TRANSLOCATIONS BY X-RADIATIONS AT DIFFERENT STAGES OF GERM CELL DEVELOPMENT IN DROSOPHILA VIRILIS. (abstr.) Genetics 39 (1954) 956.

Induced translocations were used to demonstrate genetic damage to different stages of developing germ cells under several different physiological conditions. Males, 15 to 30 h after eclosion, were x-radiated 2000 r in 1 min at 0-5°C in a gas mixture with suitable pre- and post-treatment, mated individually to three marker females for 5 d; thereafter each male was remated every 48 h for 9 (A-I) mating periods. The first sperm used in inseminating females in lots A and B represent the advanced stages at irradiation; sperm used in subsequent matings were from earlier stages back to spermatogonia by H and I. In most tests the percent of translocation in B (7-9 d) corresponded to the values obtained for mature sperm treated under the same conditions. By D (11-13 d) or E (13-15 d) the frequency increased two or threefold. The values for air at the peak were 25 to 28% as compared to 17.2% for mature sperm from earlier experiments; in 96% N_2 + 4% O_2

the rate was 32% compared to 14%. In 95% CO+5% O_2 there was a 39% peak at D and E, then an increase to 76% at F. After the peak, the rate drops to a value of 1% and less (spermatogonia). Early pupae produced a few offspring from meiotic or post meiotic stages with a translocation rate equivalent to that in the carbon monoxide mixture, then the rate fell to that of spermatogonia.

1161 Alexander, M. L. DOMINANT LETHAL AND TRANSLOCATION DAMAGE IN THE IMMATURE GERM CELLS OF DROSOPHILA VIRILIS FROM FAST NEUTRONS. Genetics 41 (1956) 631-2.

The postmeiotic germ cells of Drosophila virilis show an increase in translocation damage which follows a "one-hit" curve and increases in proportion to the increase in the dose of fast neutrons. The damage in the more mature cells (A & B) was 2.47% translocations at the lowest dose (estimated dose of 65 rep) and increased to 5.95% when the dose was doubled (130 rep) and 13.78% for 260 rep. The most sensitive cells recovered were from mating period D and gave values of 6.03% translocations for the lowest dose, 8.29% for the second and 20.00% for the highest dose. The intermediate period (C) gave values which were intermediate between these two types. The most sensitive cells show 2.4 times more damage than the less sensitive cells of period A and B at the 65 rep dose level. No translocations were recovered from the premeiotic cells (periods F, G, H). The dominant lethal damage was measured throughout the cycle in both pre- and postmeiotic cells. In the postmeiotic cells, the highest peak of damage measured as dominant lethals coincided with the high point of translocation damage and the dominant lethal damage was increased about 1.5 to 2 times in the most sensitive cells at the 65 rep dose level. The damage in premeiotic cells dropped to a value of 14 to 17% as compared to 40% for the most sensitive cells recovered from mating periods D and E. Small egg samples were checked for the presence of sperm in some mating periods to distinguish between cell degeneration, as expressed as an absence of mature sperm, and genetic lethality. None of the eggs checked in period G contained sperm thus showing the absence of available sperm in this period. Neither the previous period (F) nor following period (H) showed an indication of this type damage.

(Abstract of paper presented at the 1956 meetings of the Genetics Society of America, Storrs, Conn., USA 27-29 Aug. 1956)

1162 Alexander, M. L. DOMINANT LETHAL DAMAGE IN THE IMMATURE GERM CELLS OF DROSOPHILA VIRILIS FROM 220 kV X-RAY, 1.17 - 1.33 MeV GAMMA RAYS AND 22 MV X-RAY. Genetics 42 (1957) 357.

Young males of D. virilis (18-21 h old) were treated with one of three types of irradiation: 200 kV x-ray, 1.17 - 1.33 MeV gamma rays from a cobalt-60 source, and 22 MV x-ray from a betatron source. The treated males were remated every two days to females which were obtained from a heterosis cross of two other virilis strains. Samples of the germ cells treated in various pre- and postmeiotic stages were obtained by this remating procedure. The dominant lethal damage in the different types of cells was measured by the percentage of pupae development from the egg samples obtained from females used for the different mating periods. Translocation tests were used to distinguish the postmeiotic from meiotic and premeiotic cells. With all three types of radiations, the highest percentage of dominant lethals in the postmeiotic cells was produced in the young spermatids. Less damage was observed in the more mature cells. With the dose expressed in rads, the gamma rays and 22 MV x-rays 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 0.72 for postmeiotic cells. The high proportion of dominant lethals induced in young spermatids was retained in sperm samples from germ cells treated in the meiotic and premeiotic stages both with gamma rays and 22 MV x-rays. 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 postmeiotic cells for each of the three types of radiation were consistent at levels of 500, 1000 and 2000 r.

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

1163 Alexander, M. L. DOMINANT LETHAL DAMAGE IN MEIOTIC AND SPERMATOGONIAL CELLS OF DROSOPHILA VIRILIS WITH 22 MV X-RAY AND 200 kV X-RAY. Radiation Res. 9 (1958) 85.

Dominant lethals produced by radiations in meiotic and spermatogonial cells result from at least two observable radiobiological actions. Some cells degenerate in the testes of treated males, and periods of sterility result from a reduction in the number of mature sperm. Another type acts as a lethal after fertilization and prevents completion of embryonic development. With fast neutrons and gamma rays, both lethal types were recovered, although the proportions of the two may not be the same. Lethal damage

produced in spermatogenesis with 22 MV x-ray (betatron source) was previously obtained for doses from 435 to 2000 rads. In meiotic and especially spermatogonial cells, equal or even greater amounts of lethal damage were recovered with the same dose of 22 MV x-ray as with 200 kV x-ray. Sensitivity of meiotic and some spermatogonial cells in Drosophila have been underestimated. Increases of 20% lethals have been recovered with 190 rads of 200 kV x-ray and 22 MV x-ray (170 rads). Doses of 2000 rads of both radiations produced maximum damage: 98% 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-ray was necessary than with 200 kV x-ray. In postmeiotic, immature spermatids, 200 kV x-ray produced higher lethal values than 22 Mv x-ray and RBE values from 0. 64 to 0. 76 were obtained.

(Abstract of paper presented at the Intern. Congr. of Radiation Research, Burlington, Vermont, 10-16 Aug. 1958)

1164 Alexander, M. L. BIOLOGICAL DAMAGE IN DEVELOPING GERM CELLS OF DROSOPHILA VIRILIS IN OXYGEN AND NITROGEN WITH 14-MeV NEUTRONS. Proc. nat. Acad. Sci., Washington 44 (1958) 1217-28.

Germ cells of D. virilis were exposed in spermatogenesis to neutrons in oxygen and nitrogen atmospheres. Dominant lethals and translocations induced in the post-meiotic stage were considerably higher in an O_2- than in an N_2-atmosphere. Spermatids showed a greater difference than spermatozoa. The similarity in shape of the two curves for induced translocations indicates that the difference 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 O_2 but with the same frequency in N_2. The particular gas used had no effect on the number of lethals induced by radiation in spermatogonia.

1165 Alexander, M. L. RADIATION DAMAGE IN THE DEVELOPING GERM CELLS OF DROSOPHILA VIRILIS FROM FAST NEUTRON TREATMENT. Genetics 43 (1958) 458-69.

The radiation damage produced by the densely ionizing radiations from fission neutrons was tested by studies of various stages of post- and premeiotic germ cells of Drosophila virilis. Young males were treated with doses of 600, 1200 and 2400×10^8 n^f/cm^2 and the various types of cells sampled by successive remating 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 spermatogenic cycle resulted in a curve which would be expected when multiple chromosome breakage is 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 (B-D) varied in sensitivity to chromosome breakage with the sensitivity peak occurring in the spermatozoa sampled 13 - 15 d after treatment (Period D). 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 the D types. 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 spermatozoa in the treated males in mating period G indicated that some types of spermatogonial germ cells degenerate as a result of neutron irradiation. The relative biological efficiency of fission 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 - [1356]

1166 Alexander, M. L. THE EFFECT OF RADIATION OF DIFFERENT ION DENSITIES ON THE GERM CELLS OF DROSOPHILA VIRILIS. p. 51-70 in "Radiation Biology and Cancer. A collection of papers presented at the 12th Annual Symposium on Fundamental Cancer Research 1958". Austin, University of Texas Press. 1959, 493 p.

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 radiations 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 biological damage to a greater degree with x-rays than with neutrons. Data are presented from a series of studies on dominant lethal and translocation damage in spermatogenesis; radiation damage with 200 kV x-radiation, 1.71 and 1.33 MeV gamma rays, and 22 MV x-radiation; the effect of fast neutrons on gametogenesis; and the influence of environmental factors on radiation damage. (NSA 13: 21905, 1959)

1167 Alexander, M. L., Bergendahl, J., Brittain, M. BIOLOGICAL DAMAGE IN MATURE AND IMMATURE GERM CELLS OF DROSOPHILA VIRILIS WITH IONIZING RADIATIONS. Genetics 44 (1959) 979-99.

Data on translocation and dominant lethal damage are tabulated for 200 kV x-rays, γ-rays from Co^{60} and 22 MV x-rays from a 31 MeV betatron source, from 500 - 2000 r. The comparative effectiveness is discussed. The average RBE values for postmeiotic cells were 1.00: 0.86: 0.70 for therapy x-rays, γ-rays and betatron x-rays. The percentage of biological damage produced by the various radiations agree in a quantitative manner with the physical measurements of linear transfer or ion density per micron of the radiations. The agreement in the differences in ion density and difference in biological damage depends upon the method for calculating the LET. 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 - [854]

1168 Auerbach, C. SENSITIVITY OF THE DROSOPHILA TESTIS TO THE MUTAGENIC ACTION OF X-RAYS. Z. indukt. Abstamm. -VererbLehre 86 (1954) 113.

Young males which had undergone irradiation were mated at set intervals, and the resultant "brood pattern" of mutation frequencies analysed 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 spermiogenesis. With maturation of the sperm, sensitivity declines again to about half its peak-period value.

1169 Baeumer, J., Müller, K. BEITRAG ZUR DOSIERUNG DER BETA-STRAHLEN DES RADIUMS NACH DER BIOLOGISCHEN METHODE. I. MITTEILUNG (Dosimetry of β-rays from radium by the biological method. I.) Strahlentherapie 87, 2 (1952) 310-4. (In German)

1 - 3 h old Drosophila eggs were used for the measurement of β-radiation from radium in r units. The damage curve of a Ra preparation, prefiltered with 2 mm monel, was compared with that of known hard roentgen radiation. From the ratio between total radiation and γ-radiation, the β-radiation could be determined. At a 1 cm local distance the proportion of γ : β was 1 : 8. It was confirmed that the sensitivity of D. eggs to radiation is independent of wave length as long as this is below 0.05 Å. (EM 14, 7 (1953) 1739)

1170 Baeumer, J., Hofmann, D., Kepp, R. K., Müller, K. BEITRAG ZUR DOSIERUNG DER BETASTRAHLEN DES RADIUMS NACH DER BIOLOGISCHEN METHODE (Dosimetry of β-rays from radium by the biological method). Strahlentherapie 90 (1953) 143-7. (In German)

In Drosophila eggs of a medium age of 2 h, the depth of penetration was determined and the spatial dose distribution of the total radiation from a Ra preparation (filtered through 2-mm monel metal) in an aluminium 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 β-radiation. The practical range of the radiation amounts to 4.2 mm. The share of the γ-radiation can be neglected. (CA 47: 6993c, 1953)

* Baker 1957 - [940]

1171 Balock, J. W., Christenson, L. D., Burr, G. O. EFFECT OF GAMMA RAYS FROM COBALT-60 ON IMMATURE STAGES OF THE ORIENTAL FRUIT FLY (DACUS DORSALIS HENDEL) AND POSSIBLE APPLICATION TO COMMODITY TREATMENT PROBLEMS. (abstr.) Proc. Hawaii. Acad. Sci. 31 (1956) 18.

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 36 000 r, reduced ~ 24% by 60 000 r and 46% by 120 000 r. Complete development from irradiated egg to adult was possible with a dosage of approximately 2000 r, and the resulting adults

mated and produced normal progeny. Dosages in the range of 7500 to 60 000 r permitted puparial development but this was greatly reduced at 30 000 and 60 000 r at which levels the pupation was only 0.5%; 120 000 r permitted development to 3rd-instar larva but prevented puparial formation. Third-instar larvae exposed to irradiations from 15 000 to 240 000 r survived and from 37 to 70% formed puparia but were unable to develop to 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 300 000 r, the complete development of irradiated eggs and larvae to the adult stage is prevented by dosages of 7500 and 15 000 r. (from abstr.)

1172 Bateman, A.J. MUTAGENIC SENSITIVITY OF MATURING DROSOPHILA SPERM. I. DOMINANT LETHALS. J. Genet. 54 (1956) 400-10.

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, 0.83%, was taken to be the spontaneous rate of dominant lethal mutations. Irradiation of mature sperm gave an induced dominant lethal rate of 12.23%, corresponding to a doubling dose of 68 r. The change in dominant lethal rate from day to day was interpreted as a 10-fold increase in sensitivity to mutagens in the immediately post-meiotic spermatids followed by a gradual decrease from 6 d prior to maturity until the day before full maturity. The last 2 d were the only period (since the pre-meiotic stages) over which no change in sensitivity was detectable. The doubling dose for the most sensitive stage is 7 r. Whilst mature sperm have remained viable at the highest dose used (30 000 r), immature sperm were killed by 10 000 r. The sensitivity of spermatogonia to chromosome breakage is probably of the same order as for mature sperm. Meiotic stages are probably killed by a dose of the same order as produces 100% dominant lethals in immature sperm. (from auth. summary)

1173 Bateman, A.J. MUTAGENIC SENSITIVITY OF MATURING DROSOPHILA SPERM. II. DELETED X'S. J. Genet. 55 (1957) 467-75.

It is known that the early post-meiotic stages of Drosophila sperm are more sensitive than mature sperm to the mutagenic effects of x-rays. To study this phenomenon in more detail and in a more quantitative way the authors 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 30- 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.J. MUTATIONS IN IRRADIATED SPERMATOCYTES. Drosophila Inform. Serv. 32 (1958) 113.

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

1175 Belgovsky, M.L. THE SHAPE OF FREQUENCY-DOSAGE CURVE FOR RECESSIVE LETHALS IN DROSOPHILA IN RELATION TO DIFFERENTIAL RADIOSENSITIVITY OF DIFFERENT STAGES OF GERM CELL DEVELOPMENT. p. 19 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

Wild-type Drosophila males were treated with 1000 r and 4000 r of x-rays and the frequency of recessive lethals recorded for gametes which, at 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. This study shows that the possible heterogeneity of the stage of development of the treated germ cells, not considered 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.

1176 Belgovsky, M. L., Abeleva, E. A., Potekhina, N. A. THE NATURE OF THE RELATION OF THE FREQUENCY OF LETHALS ARISING AT DIFFERENT STAGES OF SPERMATOGENESIS TO THE DOSE OF X-RAYS. Dokl. Akad. Nauk SSSR 124 (1959) 922-4. (In Russian)

A series of special experiments was carried out in order to discover the dependence on dose (for 1000 - 4000 r) of lethals arising in Drosophila melanogaster (Algerian and Ebreo) mature sperm, spermatids and during spermatogenesis. The tabulated data show that the frequency of lethals in spermatids induced by 4000 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 - [1370]

1177 Borstel, R. C. von. FEULGEN-NEGATIVE NUCLEAR DIVISION IN HABROBRACON EGGS AFTER LETHAL EXPOSURE TO X-RAYS OR NITROGEN MUSTARD. Nature 175 (1955) 342-3.

Female Habrobracon 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 mutagens discussed. (NSA 9: 3024, 1955)

* Borstel and Rogers 1958 - [906]

* Brandt and Höhne 1952 - [1372]

1178 Bucher, N. ZUR ENTWICKLUNG RÖNTGENBESTRAHLTER OVARIEN VON DROSOPHILA MELANOGASTER (Concerning the development of x-irradiated ovaries of D. melanogaster). Arch. Klaus-Stift. VererbForsch. 26 (1951) 479. (In German)

The Drosophila ovary is composed of 2 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 later, in female larvae ready for pupation, and in 8-h pupae (3500 - 5000 r). Nowhere were follicles formed before treatment, and the complete extirpation of ovarian cells could be accomplished with practically no damage to somatic tissues. In flies which had been x-rayed as 24-h old pupae no undivided ovarioles could be found. Instead of ripe egg cells 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 pupation. If follicle formation is stimulated, this is independent of the development of the enclosed germ cells. In the genesis of the ovary both dependent and autonomous phenomena of development occur.

1179 Buretz, K. M. THE EFFECTS OF VARIOUS IONIZING RADIATIONS ON THE SURVIVAL OF METAPHASE I AND PROPHASE I EGGS OF HABROBRACON JUGLANDIS (ASHMEAD). Bachelor's Thesis. Delaware, Univ., Newark, 1956.

1180 Buzzati-Traverso, A. A. DIFFERENTIAL EFFECT OF X-RAYS ON DROSOPHILA EGGS DERIVED FROM RECIPROCAL CROSSES IN DROSOPHILA MELANOGASTER. Atti Ass. genet. ital. 5 (1960) 113-5. (CNEN-12) (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-h-old eggs of D. melanogaster obtained from the cross ♂ y w^a cv v f × ♀ + and its reciprocal y w^a cv v f ♂ + × ♀ were x-rayed with doses of 340 and 680 r. While no significant differences were found in the frequencies of somatic mutants, as revealed by mosaics, unexpected differences were found in the egg mortality and in the sex ratio of the surviving adults. The data are tabulated. (from auth.)

* Chandley and Bateman 1960 - [857]

* Colombo 1959 - [1247]

* Crook et al. 1960 - [1114]

1181 Crouse, H. V. THE DIFFERENTIAL RESPONSE OF MALE AND FEMALE GERM CELLS OF SCIARA COPROPHILA (DIPTERA) TO IRRADIATION. Amer. Nat. 84 (1950) 195-202.

Comparative studies have been made on the response of male and female germ cells of S. coprophila to irradiation. The following results were obtained: (1) When adult females are exposed to x-rays 43 to 45.5 h after eclosion, no gross rearrangements of any type are recovered; but oöcytes irradiated between 46 and 72 h of adult life yield inversions. (2) Approximately the same number of breaks leading to gross rearrangements are induced by 2000 r in oöcytes and 4000 r in sperm. (3) Irradiation of sperm results in both reciprocal translocations and inversions. (4) Tests for reciprocal translocations involving the X-chromosome yielded 9 such translocations among 108 sperm tested but none among the 42 oöcytes examined. The failure to recover interchromosomal exchanges following irradiation of oöcytes is discussed. (auth.)

1182 Dittrich, W., Fass, H., Höhne, G., Schubert, G. DIE WIRKUNG SCHNELLER ELEKTRONEN EINES 6 MeV-BETATRONS AUF EIER VON DROSOPHILA MELANOGASTER (The effects of fast electrons from a 6 MeV-betatron on eggs of Drosophila melanogaster). Strahlentherapie 81, 2 (1950) 223-32. (In German)

Lethal dose rates on Drosophila eggs of different ages were determined for fast electrons and x-rays, in order to test differences in their biological effects. For 3-h eggs the curves for rate of damage coincided. The exponential rise in the case of fast electrons also points to the existence of a single-hit reaction. On $7\frac{1}{2}$-h eggs they are somewhat less effective than x-rays. Multiple-hit reactions are caused by both radiations, with a greater number of hits from fast electrons. Differences in the effects of the two kinds of radiation may be assigned to differences in differential ionization.

1183 Fiala, Y., Neubert, J. DIE ERZEUGUNG VON CHROMOSOMENDISLOKATIONEN DURCH RÖNTGEN-STRAHLEN IN DER KEIMBAHN UND IN GESCHLECHTSZELLEN VERSCHIEDENEN ALTERS BEI DROSOPHILA HYDEI STURT (X-ray-induced chromosome dislocations during gametogenesis and in germ cells of various ages in Drosophila hydei Sturt.). Chromosoma 4 (1952) 577-84. (In German)

X-ray-induced chromosome dislocations could be observed in the giant chromosomes of F_1-larvae. Dislocation rates following irradiation are given for mature spermatozoa, spermatocytes and unfertilized eggs. By irradiating mature larvae and pupae it is also possible to induce dislocations in the early stages of gametogenesis, which are then passed on through the germ cells.

1184 Fluke, D. J. THE EFFECT OF X-RAYS ON EGG HATCH AND EGG LAYING IN MORMONIELLA. (abstr.) Radiation Res. 7, 3 (1957) 315.

An egg-hatch test on agar plates for Mormoniella has been applied to study stages of radiosensitivity in oögenesis in comparison with results of other workers with Habrobracon and Drosophila. Unmated females which had previously fed and laid eggs were starved and then x-rayed (250 kV potential or heavily filtered 50 kV). The hatch of an initial group of eggs showed sensitivity corresponding generally to the stage correlated with metaphase I by A. R. Whiting in Habrobracon or to stage 14 defined by R. C. King in Drosophila. The number of eggs in this stage was several times the number for Habrobracon. As egg laying was continued an intermediate phase of radiosensitivity appeared, but the egg hatch did not recover to a resistant phase corresponding to Habrobracon prophase I or to Drosophila stage 7. In an attempt to find such a resistant phase, females in successively earlier stages were x-rayed. Females x-rayed after eclosion but before first feeding did succeed in reaching a resistant phase before egg laying ceased. As progressively earlier pupal stages were irradiated the resistant phase was reached sooner, but progressively fewer eggs were laid before egg laying stopped. The effect on number of eggs laid set in so sharply with increasing dose that it has not been possible to compare the resistant phase very definitely with Habrobracon prophase I or with Drosophila stage 7.

* Frey 1952 - [821]

1185 Fritz-Niggli, H. BIOLOGISCHE ANALYSE DER STRAHLENSCHÄDIGUNG VON DROSOPHILA-EIERN DURCH 180 kV RÖNTGENSTRAHLEN UND ULTRAHARTE 31 MeV-STRAHLEN (Biological analysis of the radiation damage to Drosophila eggs during 180-kV x-radiation and ultrahard 31-MeV radiation). Naturwissenschaften 39 (1952) 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 1¾ 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 intoxication which only becomes evident later. In order to kill 5½-8 h-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.

1186 Fritz-Niggli, H. VERGLEICHENDE ANALYSE DER STRAHLENSCHÄDIGUNG VON DROSOPHILA-EIERN MIT 180 keV UND 31 MeV (Comparative analysis of irradiation damage to Drosophila eggs caused by 180 keV and 31 MeV). Fortschr. Röntgenstr. 83 (1955) 178-200. (In German)

In view of the variation of radiosensitivity with egg age, only an age spread of ± ½ h was admitted. The effects of x-rays (180 keV) and β-rays (31 MeV) were compared on 112 014 eggs. Methods and calculations are set down in detail, and the results tabulated and discussed. Maximum sensitivity was observed at 1¾ ± (0)¼ h. Prior to differentiation cells are particularly sensitive. The kind of radiation effect (moment of occurrence, etc.) depends on dosage and age. An equal dose of 31 MeV and 180 keV radiation on 1 and 1¾ h old eggs had similar effects both qualitatively and quantitatively. On 4, 4½ and 7 h old eggs the lethal effects of 180 keV radiation was greater. With 3 h eggs, results seem to be similar but the wide spread has made it impossible to secure a mathematical comparison.

* Fritz-Niggli 1957 - [824]

* Fritz-Niggli 1958 - [825], [826], [869]

1187 Fritz-Niggli, H. DIE VERSCHIEDENE BEEINFLUSSUNG DER MUTABILITÄT REIFER UND UNREIFER KEIMZELLEN DURCH BESTRAHLUNG IN N_2-, O_2- UND CO-ATMOSPHÄRE (The varying influences on the mutability of mature and immature germ cells by irradiation in N_2, O_2, and CO atmospheres). Strahlentherpie 109 (1959) 402-11. (In German)

The rate of mutations of dominant and recessive lethal factors and translocations in Drosophila depends on the stage of development of the germ cells irradiated in air. The scale of sensibility is the same for all types of mutations, beginning at the most sensitive stage: spermatocytes, spermatids, mature sperms, spermatogonia. Irradiation in pure N_2 and CO atmosphere decreases the rate of mutation. The protection effect of CO is less than of N_2. 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 O_2 atmosphere. The rate of mutation of irradiated spermatids and spermatocytes can be decreased considerably by irradiation in pure N_2. Spermatogonia are indifferent to irradiation in N_2 atmosphere. The possibility exists that an increased proportion of O_2 of spermatids and spermatocytes, as compared to mature sperms, may explain their sensibility to milieu factors. (auth.)

* Giux Melcior 1951 - [829]

1188 Glass, B. A COMPARATIVE STUDY OF INDUCED MUTATION IN THE OÖCYTES AND SPERMATOZOA OF DROSOPHILA MELANOGASTER. I. TRANSLOCATIONS AND INVERSIONS. Genetics 40, 2 (1955) 252-67.

Spermatozoa and oöcytes irradiated simultaneously with x-rays yielded only 1 translocation in 2599 oöcytes compared to 150 in 2357 spermatozoa. The frequency of translocations from treated spermatozoa utilized 8 to 11 d after treatment was almost twice as great as the frequency in spermatozoa used sooner after treatment. All translocations induced in oöcytes 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 spermatozoa as in oöcytes. The ratio inverted ♀/inverted ♂ is 40 to 50 times as great as the corresponding ratio for translocations. This is interpreted to mean that the frequency of chromosome breakage in oöcytes differs little from that in

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

1189 Glass, B. A COMPARATIVE STUDY OF INDUCED MUTATION IN THE OÖCYTES AND SPERMATOZOA OF DROSOPHILA MELANOGASTER. II. DEFICIENCIES AND MINUTES. Genetics 40, 2 (1955) 281-96.

Dominant Minute-bristle mutations attributable to chromosome deficiencies were produced at x-ray doses from 1000 r to 4000 r with equal frequencies in oöcytes and spermatozoa. The dosage curve is rectilinear up to 2000 r, and above that the curve increases approximately as the 1.5 power of the dose; hence at low doses most Minutes result 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 oöcytes. The failure of gross chromosomal rearrangements to occur in the latter must be attributed to a diminution, more rapid in the oöcytes than in spermatozoa, of the probability of recombination between breaks as distance between them increases.

1190 Glass, B. DIFFERENCES IN MUTABILITY DURING DIFFERENT STAGES OF GAMETOGENESIS IN DROSOPHILA. p. 148-67 (disc. p. 167-70) in "Brookhaven Symposia in Biology, 15-17 June 1955", Vol. 8. BNL-350 (C-22), Brookhaven National Lab., Upton, N.Y. 1957.

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 rate, and of the period of gametogenesis on the induced mutation rate in males and in females are examined in some detail. If the genetic effects of high energy radiation are to be assessed successfully, the differences 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.

* Glemobitsky et al. 1960 - [993]

* Grosch 1960 - [1139]

* Gund and Paul 1950 - [831]

* Heidenthal and Clark 1951 - [1254]

* Heidenthal 1952 - [998]

* Heidenthal et al. 1954 - [832]

* Heidenthal et al. 1955 - [833]

1191 Heidenthal, G. GENETIC EFFECTS OF X-RAYS AND CATHODE RAYS ON OÖCYTES OF HABROBRACON. Genetics 45 (1960) 633-9.

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 the same? A conventional 124 kV x-ray machine was used for the low dose rate work; an electron beam generator which yielded a rate as high as 5000 r/s was the source of high dose rates. The materials irradiated were Habrobracon oöcytes in first meiotic prophase and metaphase stages. These were studied for hatchability or presence of dominant and recessive lethals. F_1 virgin females were reared from prophase oöcytes treated with 12 000 r. These were tested for heterozygosity with respect to recessive lethals. The data so accumulated indicate that with these materials, when total doses of x-rays and cathode rays are the same, the wide difference in dose rate has no significant effect. (auth.)

1192 Herskowitz, I. H. THE JOINABILITY OF CHROMOSOME BREAKAGE POINTS PRODUCED BY X-RAYS IN DROSOPHILA OÖCYTES. Science 119 (1954) 581.

Oöcytes, containing an attached-X but no Y chromosome, were x-rayed with 1000 and 4000 r to obtain the detachments of the arms of the attached-X, which in Rapoport's view represent "healed" breakages. The data indicate a less random distribution of the breakage points among the autosomes partaking in translocations in the case of oöcytes than is known for spermatozoa. These observations make untenable the view

that new telomeres are formed following x-ray breakage of oöcyte chromosomes. They suggest that the orientation of the chromosomes during and after irradiation is a major factor influencing the numbers and kinds of joinings by points of chromosome breakage. (from abstr.)

1193 Herskowitz, I. H., Abrahamson, S. THE EFFECT OF X-RAY INTENSITY ON THE RATE OF SEX-LINKED RECESSIVE LETHAL MUTATION INDUCED FOLLOWING TREATMENT OF DROSOPHILA OÖCYTES. Drosophila Inform. Serv. 29 (1955) 125.

A concentrated treatment of oöcytes with about 3264 r produced significantly more sex-linked recessive lethals than did this dose delivered in a protracted manner. The data obtained strongly suggest that as many as half the lethals produced by the intense treatment are connected with multiple x-ray hits.

1194 Herskowitz, I. H. STUDIES ON THE NATURE OF RECESSIVE LETHAL MUTATIONS INDUCED IN OÖCYTES BY X-RAYS. Drosophila Inform. Serv. 30 (1956) 117-8.

Two types of adult female Drosophila ("rod/rod" and "rod/ring") were irradiated with 2300 r either in 94 s or over a 25 min period. Intense or protracted irradiation was given. About 20% more eggs were laid by rod/ring than by rod/rod females following intense treatment but this could not account for the significantly higher mutation rate of the rod X in the rod/rod female. The intensity effect on lethals demonstrates that a considerable proportion of such mutations induced in oöcytes are multi-hit events. Since it is known that broken ends produced by x-rays in oöcyte chromosomes can join soon after their production, it is suggested that the intensity-dependent lethals are connected in their origin with multi-break exchanges. Such exchanges could include small deficiencies and duplications acting as recessive lethals produced by "pseudo crossing over" — intra-tetrad exchange between nearby but nonhomologous loci.

1195 Herskowitz, I. H. A RELATIONSHIP BETWEEN TRANSLOCATION FREQUENCY AND AGE AT FERTILIZATION FOR SPERM X-RAYED IN FEMALES OF D. MELANOGASTER. Genetics 42 (1957) 375-6.

II-III translocation frequencies were determined in F_1 males from successive groups of eggs laid following treatment of inseminated females with approximately 3360 r. For the first 4 consecutive 4-d oviposition periods after treatment the rates, combined for different experiments, were, respectively, 12.3% (111/906), 14.1% (203/1432), 16.8% (201/1194), and 19.7% (115/584). (The same dose given to females before mating resulted in only one translocation in 1814 tests, hence the above translocations were paternal.) The translocation rate also increased in successive broods in each separate experiment even though the irradiation was delivered in different ways, continuously either at 1000 r/min or 1900 r/min, or discontinuously at 1900 r/min, as described in the preceding abstract.

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

1196 Herskowitz, I. H. INTENSITY-INDEPENDENCE OF TRANSLOCATIONS FROM SPERM X-RAYED IN FEMALES OF D. MELANOGASTER. Genetics 42 (1957) 375.

Approximately 3360 r were delivered to inseminated females at about 1900 r/min either (A) continuously (in 1 min 45 s) or (B) interruptedly (in 49 min 45 s) in seven 15-s irradiations given 8 min apart. The continuous treatment was also given to virgins subsequently mated with untreated males (C). The II-III translocation rates for all F_1 males tested were 0% for C (no translocations in 422 tests), 14.3% for A (121/844), and 13.7% for B (135/982). Included here are counts for A and B of all F_1 males from eggs laid in the first 4 successive 4-d periods following irradiation. When individual 4-d 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 protracting the irradiation has no significant effect on translocation rate.

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

1197 Herskowitz, I. H., Abrahamson, S. INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. I. DEPENDENCE OF HALF-TRANSLOCATION FREQUENCY UPON X-RAY DELIVERY RATE. Genetics 41 (1956) 420-8.

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 eucentrically to a piece of another broken chromosome, the other, reciprocal, pieces becoming lost) were employed as a measure of multi-break chromosomal rearrangements induced by x-rays administered at various concentrations to D. melanogaster oöcytes. Higher concentrations

produced more half-translocations than lower ones, proving that breaks in oöcytes can join in new arrangements before fertilization, not as breaks in fully mature spermatozoa (those in inseminated females). The results show that, of the joinings which will take place, the great majority do so within 8 h, and that about 1/2 do so within 4 h. Under certain experimental conditions at least 1/2 the breaks that join can do so within 1/4 h, but under other conditions joinings 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 Y chromosome on their increased frequency is confirmed. It was found again that, among oöcytes oviposited during the first 4 d 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-d period when the treatments were more concentrated. (from auth.)

1198 Herskowitz, I. H., Schalet, A. INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. V. THE CONTRIBUTION OF HALF-TRANSLOCATION AND NONDISJUNCTION TO THE DOMINANT LETHALITY INDUCED BY X-RAYING OÖCYTES. Genetics 42 (1957) 648-60.

Experiments are described which determined the frequencies with which about 2000 r delivered in an intense manner to oöcytes produced real and apparent nondisjunctions of the X chromosome or eucentric half-translocations resulting in mature eggs hyperploid for all or almost all of IIR. The product of the latter event, inviable in the egg stage after fertilization by normal sperm, was made viable, by crossing treated females to males which produce sperm some of which are hypoploid for IIR, and also recognizable, by both parents having their chromosomes suitably marked with genetic factors. The genetic basis for at least 1/9 of the 40% egg mortality induced by 2000 r, including 1/6 of the established intensity-dependent component, is accounted for, following analysis of the data obtained. (from summary)

* Herskowitz 1957 - [1140]

1199 Herskowitz, I. H., Abrahamson, S. INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. IV. DEPENDENCE OF INDUCED CROSSOVER-LIKE EXCHANGES IN OÖCYTES AND OÖGONIA UPON X-RAY INTENSITY. Genetics 42 (1957) 444-53.

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 fractionated dose.

1200 Herskowitz, I. H. GENETIC RECOMBINATION INDUCED BY X-RAYS IN FEMALE GERM CELLS OF DROSOPHILA. p. 118 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

The kinds and frequencies of x-ray induced genetic recombination in female germ cells of Drosophila depend upon their stage in differentiation. In most mature cells many breaks are produced. Some rejoining 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.

1201 Herskowitz, I. H. INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. VI. THE EFFECT OF DEHYDRATION UPON THE X-RAY-INDUCED FREQUENCIES OF CROSSOVER-LIKE EXCHANGES AND OF GROSS CHROMOSOMAL REARRANGEMENTS. Genetics 44 (1959) 329-39.

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 carnation and the centromer). 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 detaching 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, obtained earlier when dehydration preceded x-raying, 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 restitute. (auth.)

* Herskowitz and Baumiller 1959 - [1001]

1202 Herskowitz, I. H., Muller, H. J., Laughlin, J. S. THE MUTABILITY OF 18 MeV ELECTRONS APPLIED TO DROSOPHILA SPERMATOZOA. Genetics 44 (1959) 321-7.

Sperm in inseminated females were either untreated or treated with 600, 1500 or 3750 rads of 18 MeV electrons and different types of mutation involving the paternal chromosomes were detected among the offspring. Partial or complete sex chromosome loss increased slightly, but significantly, faster than linearly with dose; II-III reciprocal translocations increased approximately as the 3/2 power of the dose; and sex-linked recessive lethal mutations increased approximately linearly with dose. The shapes of all three curves are in good agreement with previous x-ray results. (auth.)

* Hirobe and Oi 1958 - [1556]

1203 Ives, P. T. RELATIONSHIP BETWEEN RADIATION DOSE AND DOMINANT VISIBLE MUTATION RATE IN DROSOPHILA MELANOGASTER. Genetics 44, 2 (1959) 967-78.

Over a broad dosage range, the relationship between rate of sex-linked lethal mutations and radiation dose (Co^{60} γ-radiation was used) is apparently linear. Results of tests are presented on the frequency of easily seen visible mutations, chiefly autosomal dominants, at 10 dosage levels in the 0.5 kr to 10 kr range. Their relation to data from the sex-linked lethal tests is discussed. The total mutation rate increased as the 1.2 power of the dose between 0.5 and 4 kr, and as the 1.5 power at higher doses, suggesting a mixture of one-hit and two-hit mutations at the lower doses and chiefly position effect rearrangements in the 5 - 10 kr range. The two-phase exponential rate-dose relationship observed for visibles is compared to the linear relationship observed for X-lethals and is attributed in part to the apparently much lower proportion of chromosomal rearrangements in lethal X chromosomes and, in part, to a combination of other factors which are discussed.

* Kaufman and Wasserman 1957 - [1121]

* Kenworthy 1954 - [1393]

* King 1955 - [1013]

* King and Wood 1955 - [1012]

* King et al. 1956 - [1014]

* King 1957 - [917]

* King 1958 - [1015]

* Kishin 1955 - [1146]

* Kogure and Nakajima 1958 - [1147]

1204 Koiwai, S. MEIOTIC ABNORMALITIES INDUCED BY THE EXPOSURE TO RADIUM IN GRASSHOPPER (PODISMA SAPPORENSE) SPERMATOCYTES. Jap. J. Genet. 32, 5 (1957) 165-7. (In Japanese, summary in English)

Nymphs of a grasshopper (Podisma sapporense) were exposed to Ra 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: coalescence and stickiness of chromosomes, formation of chromosome bridges, varying numbers of chromosomes, irregular arrangement of chromosomes in the metaphase plate fragmentation of chromosomes. The types of abnormality closely resembled that caused by a treatment with high or low temperature, and by exposure to supersonic waves.

* Lamarque 1951 - [1282]

* Lamarque 1952 - [1283]

* Lamarque and Gary-Babo 1956 - [838]

* Langendorff and Sommer 1950 - [1256]

* Lefevre 1950 - [1022], [1023]

* Lindsley et al. 1958 - [951]

1205 Lüning, K. G. X-RAY INDUCED DOMINANT LETHALS IN DIFFERENT STAGES OF SPERMATOGENESIS IN DROSOPHILA. Hereditas 38, 1 (1952) 91-107.

Wild type, sc^{51} B In-S w^a sc^8 (Muller-5) and y w sn males of Drosophila melanogaster were irradiated with 2900 r and mated immediately or after some days in mass or in pair cultures to y w sn females. In most series the males were transferred to new females every single or every third day. In the first 5 d after treatment the rate of dominant lethals is practically constant. There is then a more or less sharp increase in the rate, which remains until the 11th day when there is a sharp decrease which continues to the 20th day. Males irradiated at an age of 0 - 1 d showed a sharper increase in the rate of dominant lethals than males which were 6 - 7 d at treatment. (from auth. summary)

1206 Lüning, K. G. X-RAY INDUCED CHROMOSOME BREAKS IN DROSOPHILA MELANOGASTER. Hereditas 38, 3 (1952) 321-38.

Details of irradiation and mating procedures are given. A much higher rate of x-ray induced chromosome aberrations was observed in spermatids than in spermatozoa whereas the rates of induced recessive lethals showed little difference. Sensitivity is found to be not only dependent on the stage of spermatogenesis treated but also on the age of the male being treated. The implications of the discrepancy between the results of dominant lethals and hyperploid males versus gene mutations and gynandromorphs are discussed; it is supposed that — at least in some stages — breaks are induced that are not associated with gene mutations.

1207 Lüning, K. G. THE BREAKABILITY OF CHROMOSOMES IN DROSOPHILA MELANOGASTER SPERMATOZOA AFTER X-RAY IRRADIATION OF IMPREGNATED FEMALES AND OF MALES. (abstr.) p. 893 in "Proceedings of the 9th International Congress on Genetics, Bellagio, Italy 1953", Suppl. to Caryologia 6. Montalenti, G., Chiarugi, A., eds. Florence, 1954.

In a recent study it was shown that a higher rate of sex-linked lethals is induced in Drosophila melanogaster spermatozoa when these are x-ray irradiated in impregnated females than when irradiated in males. It has also been shown that the rate of chromosome breaks varies during spermiogenesis. Therefore, in order to investigate if the differences in the rates of sex-linked lethals also could be due to differential breakability of the chromosomes, a comparison was made of the rates of certain types of mutations which were known to be the result of intergenic rearrangements. These types were: yellow mutations produced by irradiation of the "Muller-5" X-chromosome of males; and hyperploid males produced after irradiating of both "Muller-5" and of Canton-S males. Furthermore, by a special technique, the rates of losses of whole X- and Y-chromosomes were checked. In all these cases the rates were higher when the spermatozoa were irradiated in impregnated females than when irradiated in males. By analogy, then, it is supposed that it is an increase in breakability of the chromosomes which is responsible for the higher rate of sex-linked lethals in the paternal chromosomes when comparison is made between irradiation of impregnated females and irradiation of males.

* Lüning 1954 - [1400]

1208 Lüning, K. G. VARIATIONS IN THE BREAKABILITY OF CHROMOSOMES IN MATURE SPERMATOZOA OF DROSOPHILA MELANOGASTER AT DIFFERENT MODES OF IRRADIATION. Heredity 8, 3 (1954) 211-33.

Slightly more recessive lethals are induced in spermatozoa when irradiated within females than when in males (cf. Bonnier and Lüning, 1953). It is now shown that the same is true for minute and gross rearrangements and chromosome losses. It is suggested that more breaks are induced at irradiation of spermatozoa in females than in males. The difference is greater than that for recessive lethals, to be expected on the hypothesis that only part of the recessive lethals are due to breaks, and the rate of break-independent recessive lethals is not at all, or only to a very low degree, influenced by the mode of irradiation. (from auth.)

(A brief note on the same subject was published in Drosophila Inform. Serv. 27 (1953) 99, when a higher percentage of chromosome breaks and an increase in recessive lethals were reported for sperm irradiated in females.)

1209 Lüning, K. G. STUDIES ON INDUCED MUTATIONS IN MALE AND FEMALE GERM LINES OF DROSOPHILA MELANOGASTER. Hereditas 42 (1956) 483-6.

A comparison of the mutagenic effects of x-rays on mature sperm and oöcytes shows a difference for two types of mutation, fractionals and variegated-yellow mutations. In sperm a rather high rate of fractionals is induced, rare in oöcytes. A considerable frequency of variegated-yellow mutations are, on the other hand, induced in oöcytes, 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 oöcytes. This shows that the mutation spectrum within a very small chromosomal region may differ appreciably between the sexes.

1210 Lüning, K. G., Jonsson, S. EFFECT OF FAST NEUTRONS ON DIFFERENT STAGES OF SPERMIOGENESIS IN DROSOPHILA MELANOGASTER. Nature 178 (1956) 1123-4.

1-24 h old males were irradiated by fast neutrons, and then subsequently mated to virgin females at intervals of 24, 48 and 96 h after irradiation. The offspring were analysed. It would appear that fast neutrons induce about the same rate of chromosome breaks in sperm to be inseminated during the first two days but a significantly higher rate in sperm matured for the 5th-6th day mating period. This is in agreement with the results after x-ray irradiation and consistent with the hypothesis of a differential sensitivity of various stages in spermiogenesis. It is, however, not possible to determine whether the degree of sensitivity is the same for x-rays and fast neutrons.

* Lüning and Jonsson 1957 - [1031]

* Lüning 1958 - [1288]

* Lüning and Hendriksson 1959 - [1290]

* Mossige and Oftedal 1958 - [842]

* Muller et al. 1954 - [1038]

1211 Muller, H. J., Valencia, R. M., Valencia, J. I. THE PRODUCTION OF MUTATIONS AT INDIVIDUAL LOCI IN DROSOPHILA BY IRRADIATION OF OÖCYTES AND OÖGONIA. (abstr.) Genetics 35 (1950) 126.

To study mutagenesis in interphase nuclei, females undergoing semi-starvation were x-rayed with 4600 r and then passed through a series of cultures, usually at 4-d intervals. Offspring from first cultures represented irradiated later oöcytes, with chromosomes relatively condensed, and those from later cultures "resting" oögonia or, more rarely, early oöcytes, with chromosomes attenuated. The results are summarized. None of the mutations analysed involved gross rearrangements. Chromosome breakage evidently occurs as frequently here as in spermatozoa, but union of fragments must occur fairly promptly, i.e. prior to the movements of the meiotic divisions. (from auth.)

* Muller and Valencia 1951 - [1036]

1212 Murati, K., Itô, T., Moriwaki, D., Yoshida, Y. H. AFTER EFFECT OF IRRADIATION OF THE GERM CELL OF DROSOPHILA MELANOGASTER. p. 256-9 in "Proceedings of the International Genetics Symposia, Tokyo & Kyoto, Sep. 1956". Suppl. to Cytologia 1957. Tokyo, Science Council of Japan. 1957, 702p.

Some adult males which had been x-irradiated with 6. 60 r and 4400 r were immediately mated with females, others only after 4, 8, 12, 16 and 20 d. Measured in terms of the egg-hatching rate, the rate of dominant lethals for both sets of experiments gave a steep rise between the 2nd and 10th day after irradiation, with a continued drop thereafter. With a different system of mating, irradiation by 3000 r gave a lethal rate of 7. 0% on the 5th day, and 2. 1% on the 19th day after treatment.

* Murphy 1954 - [1402]

* Nakanishi 1959 - [871]

1213 Nakao, Y. X-RAY-INDUCED VISIBLE MUTATION RATES AT THREE STAGES IMMEDIATELY AFTER OVIPOSITION IN THE SILKWORM. Radiation Res. 9 (1958) 158-9.

In the silkworm, the eggs are laid at the stage of anaphase of the first meiotic division. The second meiotic division begins 60 min after oviposition, 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 pronuclei is about 2 h at 25°C. The mutation rates and the rates of lethality induced by x-rays were examined dividing this time into three stages. As the markers, egg colour mutants were used. In the silkworm, pe and re are located on the chromosome V at 0.0 and 31.7. Both of them control the colour of the egg (and also of the eye) which is a character of the F_1 generation. Whereas the normal colour is black, pe/pe eggs are white and re/re eggs are red. Eggs homozygous for both pe and re are also white. Eggs collected from the mating of ++/++ females with pere/pere males were divided into three groups of 0-40 min, 40-80 min and 80-120 min after oviposition. Each of them was irradiated with the doses of 768 r and 1536 r of x-rays (x-ray apparatus was operated at 80 kV potential and 4 mA and the dose rate was 192 r/min). The mutation rates were calculated as the percentages of the eggs of deficient types (white or red eggs, including mosaic eggs for white or red) in the total pigmented eggs. The lethalities were also examined; susceptibility of the eggs gradually increased with progress of the stages.

(Abstract of paper presented at the Intern. Congr. of Radiation Research, Burlington, Vermont, USA, 10-16 Aug. 1958)

1214 Narayanan, E.G., Ratan Lal, Rahalkar, G.W., Sethi, G.R., Saxena, P.N. STUDIES ON THE EFFECT OF BETA RADIATIONS ON INSECTS. I. EFFECT OF BETA RADIATIONS (IRRADIATION OF EGGS AND 1ST INSTAR LARVAE) ON THE LIFE HISTORY OF CORCYRA CEPHALONICA STAINTON. Proc. Indian Acad. Sci., Sec. B 50 (1959) 82-7.

* Nickerson 1959 - [1516]

1215 Ohnuki, Y. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION AND CHEMICALS ON THE CELL AND THE CHROMOSOMES. I. TYPES OF X-RAY INDUCED CHROMOSOME ABNORMALITIES IN GRASSHOPPER SPERMATOCYTES, WITH A NOTE ON THE NORMAL COURSE OF THE FIRST DIVISION AS CONTROL. J. Fac. Sci. Hokkaido Univ. Ser. VI, 14 (1958) 83-91.

1216 Ohnuki, Y., Makino, S. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION AND CHEMICALS ON THE CELL AND THE CHROMOSOMES. II. FORMATION OF ANUCLEAR BUDS, CONTINUATION OF CHROMOSOME STICKINESS AND FORMATION OF AN ACCESSORY NUCLEUS IN GRASSHOPPER SPERMATOCYTES FOLLOWING X-IRRADIATION. Tex. Rep. Biol. Med. 18 (1960) 66-74.

1217 Oster, I.I. MODIFICATION OF X-RAY MUTAGENESIS IN DROSOPHILA. I. REUNION OF CHROMOSOMES IRRADIATED DURING SPERMIOGENESIS. Genetics 40 (1955) 692-6.

The ends of chromosomes broken during spermiogenesis undergo reunion before fertilization while the breaks produced in mature spermatozoa remain open and reunite 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. (auth.)

1218 Oster, I.I. (Indiana Univ., Bloomington, USA) EXPERIMENTS FOR THE MODIFICATION OF X-RAY MUTAGENESIS IN DROSOPHILA MELANOGASTER. Diss. Abstr. 16, 11 (1956) 2248. Thesis, 60 p.

In order to obtain further information about the conditions affecting the sensitivity of germ cells to the induction of mutations by ionizing radiation, a series of experiments was undertaken which involved studying the effects of varying different cytophysiological factors or adding supplementary chemical treatments [mustard gas (ββ'-dichlorodiethyl sulfide), urethane (ethyl carbamate), colchicine and acenaphthene] on the radiosensitivity of Drosophila melanogaster. A number of specially constructed stocks which allowed for the detection of the frequencies of induced chromosome loss, lethal mutations, and translocations were used. Modified mating procedures insured that the germ cells which were treated and tested were relatively homogeneous as regards their stage of development. An analysis of the results obtained from fractionating the dose delivered to spermatozoa and spermatids confirmed the fact that chromosome breaks produced by x-rays in mature spermatozoa do not undergo restitution or reunion until fertilization whereas breaks induced during the spermatid stage were found to undergo joining during spermiogenesis. Spermatids were shown to represent the most radiosensitive stage of germ cell development. The possible cause(s) for the similar

rates obtained after irradiating spermatids and spermatozoa bearing either a rod, a ring or Novitski's X and the dissimilar ones obtained after treating the same chromosome types during the spermatogonial stage are discussed.

1219 Oster, I. I. MODIFICATION OF X-RAY MUTAGENESIS IN DROSOPHILA. RELATIVE SENSITIVITY OF SPERMATIDS AND MATURE SPERMATOZOA. p. 475-80 in "Advances in Radiobiology. Proceedings of the 5th International Conference on Radiobiology, Stockholm 15-19 Aug. 1956". de Hevesy, G. C., Forssberg, A. G., Abbatt, J. D., eds. London, Oliver and Boyd, 1957.

A series of experiments showed that spermatids represent the most radiosensitive stage of gametogenesis in Drosophila. This did not appear to be due merely to a separation of broken chromosomes favouring disarrangement of pieces during spermiogenesis.

* Oster 1957 - [919]

1220 Oster, I. I. FREQUENCY-DOSAGE RELATIONS FOR MUTATIONS FOLLOWING X-IRRADIATION OF SENSITIVE AND RESISTANT GERM CELLS. p. 210 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

Since it is now well established that even the post-meiotic stages of spermatogenesis of Drosophila differ tremendously in their radiosensitivity and since knowledge of the relationship of lethal mutation frequency to dosage employed has a bearing on the interpretation of mutational mechanisms it was decided to reinvestigate this problem with the latest genetic techniques available. Homogeneous samples of the most radiosensitive and the most radioresistant stages of gametogenesis, represented by spermatids and oögonia, respectively, were treated. X-raying spermatids yielded 195/8978 (i. e., lethals among tested chromosomes) for 250 r and 130/1859 for 1000 r, while the controls gave 19/2392. This gives induced rates of 1. 38 ± 0. 24% and 6. 20 ± 0. 39%, indicating a linear relationship. The translocation frequencies obtained were 1. 32 ± 0. 20% (45/3421) and 9. 65 ± 0. 75% (148/1533), thereby showing a rise for these multi-break events proportional to $(dose)^{1.4}$. Irradiation of oögonia in third instar larvae yielded 117/16 064 for 600 r and 33/2056 for 2400 r, while the controls gave 49/11 630. This gives induced rates of 0. 31 ± 0. 09% and 1. 19 ± 0. 30%, again a linear relationship. For equal doses, spermatid frequencies were 12 times oögonial frequencies. Special methods ruled out the presence of pre-existing lethals as well as the inclusion of large clusters of mutations arising from one mutated cell by mitotic division. Thus at the dosages studied the strictly linear relation of lethal frequency to dosage employed was upheld for the most radiosensitive germ cells and extended to the least sensitive ones known in Drosophila. (from abstr.)

1221 Oster, I. I. RADIOSENSITIVITY. Genen en Phaenen 3 (1958) 53-66.

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 spermatozoa, 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 spermatozoa lends support to the suggestion that the high sensitivity of spermatids may at least in part be 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. (auth.) (NSA 14: 47, 1960)

* Oster 1958 - [1404]

* Oster et al. 1959 - [1049]

1222 Oster, I. I. THE SPECTRUM OF SENSITIVITY OF DROSOPHILA GERM CELL STAGES TO X-IRRADIATION. p. 253-67 in "Radiation Biology. Proceedings of the 2nd Australasian Conference held at the University, Melbourne 15-18 Dec. 1958". Martin, J. H., ed. New York, Academic Press Inc., and London, Butterworths Scientific Publ. 1959.

Various external and internal conditions are known to affect the sensitivity of chromosomes to ionizing and nonionizing 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 analysed, but techniques are available which ensure that one is treating and testing cells that represent homogeneous samples of distinct stages of mitosis or meiosis. 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 spermatid stages received less than one-half as much radiation as the spermatozoa 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. (NSA 14: 24011, 1960)

1223 Ott, A.H. DIE STRAHLENINDUZIERTE MUTATIONSRATE FÜR REZESSIV GESCHLECHTSGEBUNDENE LETALFAKTOREN IN SPERMATOGONIEN UND REIFEN SPERMIEN VON DROSOPHILA MELANOGASTER NACH BESTRAHLUNG IN LUFT UND STICKSTOFF (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). Strahlentherapie 110 (1959) 57-65. (In German)

The mutation rate (MR) for recessive sex bound lethal and semilethal factors was determined on sperms of Drosophila melanogaster which fertilized 0 to 24 ± ½ h and spermatogonia which fertilized 21 to 24 d after irradiation by 2000 r in air. On irradiated mature sperms a MR of 3.42% for lethal and of 0.73% for semilethal factors was found. After irradiation of spermatogonia 0.41% lethal and 0% semilethal factors were observed. Therefore about 9 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 MR determined for lethal and semilethal factors. On sperms a MR of 2.86% lethal and 0.30% semilethal factors was found. On spermatogonia the MR 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.)

1224 Parker, D.R., Hammond, A.E. THE PRODUCTION OF TRANSLOCATIONS IN DROSOPHILA OÖCYTES. Genetics 43 (1958) 92-100.

Attached-X female Drosophila oöcytes of various ages were irradiated, and the frequency of detachment determined in females of various ages. There is an increase in radiation sensitivity of oöcytes with aging up to 3 d, after which there is no evident increase. A two-hit formation of detachment is found both in young and old oöcytes. 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 obtained when females are aged before treatment. Speculations are made as to the possible role of cytochrome oxidase activity in the changing sensitivity of oöcytes. (auth.)

* Parker and McCrone 1958 - [955]

1225 Parker, D.R. DOMINANT LETHAL MUTATION IN IRRADIATED OÖCYTES. Univ. Tex. Publ., Biol. Contribs. 5914 (1959) 113-27.

Dominant lethals induced in stage 7 were found to follow a "2-hit" curve, while those in stage 14 were "1-hit". Evidence of participation of breakage and rejoining of chromosomes in the origin of dominant lethals is given by the finding that fractionation of the irradiation decreases while centrifuging after irradiation increases the incidence of dominant lethals in stage 7. Evidence that sister unions may occur following irradiation is given by the induction of compound X's by irradiation of inversion heterozygotes. This shows that anaphase II bridge formation might account for some dominant lethality.

(An abstract of earlier work "The origin of dominant lethals in irradiated oöcytes of Drosophila" appeared in Genetics 40 (1955) 589)

1226 Parker, D.R. THE INDUCTION OF RECESSIVE LETHALS IN DROSOPHILA OÖCYTES. Genetics 45 (1960) 135-8.

Recessive lethal induction by x-irradiation of stages 7 and 14 of primary oöcytes of Drosophila melanogaster was studied. Stage 14 gives 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 relations between sensitivity changes, breakage and rejoining, and recessive lethals. (auth.) (NSA 14: 13606, 1960)

* Passonneau 1954 - [1321]

* Ray 1957 - [875]

* Ray 1958 - [876]

1227 Ray-Chaudhuri, S. P., Ghosh, T. N., Nandi, A. K., Banerjee, G. C. X-RAY INDUCED CHROMOSOME BREAKS IN GRASSHOPPER SPERMATOCYTES UNDER VARYING CONDITIONS OF WAVELENGTH AND TEMPERATURE, AND THEIR LOCALIZATION. Proc. zool. Soc. Mookerjee Mem. (Calcutta) (1957) 115-28.

Male Gesonula punctifrons were irradiated with x-rays. The effects of different wavelengths on spermatocytes in terms of dicentric bridge formation were investigated. The chromosomes most frequently involved in bridge formation were those of medium length, not the longest. Distal breaks, i. e. relatively small fragments, are far more frequent than proximal ones. The number of dicentric bridges at longer wavelength is 3. 5 times greater, but as pointed out in the discussion, the ion density/μ at 200 kV, $\lambda = 0.06$ Å is 5 times greater than at 1000 kV, $\lambda = 0.01$ Å.

* Rogers and Borstel 1957 - [922]

* Rudnicki 1959 - [844]

* Sävhagen 1960 - [877]

1228 Schinz, H. R., Fritz-Niggli, H., Frey, E. EFFECT OF ULTRA-HARD RADIATION (31-MeV-BETATRON) ON THE EGGS OF DROSOPHILA MELANOGASTER. Experienta 8 (1952) 16-8. (In German)

The following LD_{50}'s were determined for Drosophila melanogaster eggs of 3-, 4-, and 7. 5-h age, respectively; 200, 460 and 825 r for 180-keV x-radiation; 200, 1225 and 1060 r for 3-MeV electrons; and 237, 1117 and 1167 r for 31-MeV x-radiation. Lethal-dose curves are plotted. Reasons for the lower biological effectiveness of the hard 31-MeV radiation are discussed. (NSA 6: 2266, 1952)

1229 St. Amand, W. RADIOSENSITIVITY OF THE UNFERTILIZED HABROBRACON EGG DURING MEIOSIS AND EARLY CLEAVAGE. (abstr.) J. Tenn. Acad. Sci. 31, 2 (1956) 138.

In Habrobracon oögenesis is arrested near the end of the first meiotic division, and meiosis 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 observation or given 500 r of x-rays (ca. LD_{50} dose for unlaid arrested eggs) for hatchability testing. The "age" of each egg (oviposition to fixation or irradiation) is known to within 1 min. The results indicate that (1) eggs just before or just after oviposition are about equally radiosensitive; (2) the meiotic stages from the arrested stage to anaphase II show no great fluctuations of radiosensitivity; (3) the pronuclear stage is much more radiosensitive than is prophase of the first cleavage division, and (4) there is a progressive increase in radiosensitivity from the first to the third cleavage division.

* Stone et al. 1954 - [927]

* Strunnikov 1960 - [900]

* Tahmisian and Adamson 1950 - [1420], [1323]

* Tahmisian and Adamson 1951 - [928]

* Tahmisian and Vogel 1953 - [848]

* Tahmisian and Devine 1954 - [1327]

* Tahmisian and Wright 1956 - [1329]

1230 Tazima, Y. RADIOBIOLOGICAL STUDIES ON THE SILKWORM. I. X-RAY IRRADIATION DURING PUPA STAGE AND SENSITIVITY OF GERM CELLS. Papers from Coordinating Committee for Research in Genetics 2 (1951) 153-62. (In Japanese, with summary in English)

1231 Tazima, Y., Ohta, N. RADIOBIOLOGICAL STUDIES ON THE SILKWORM. II. ON THE SENSITIVITY OF MALE GERM-CELLS OF THE FIFTH INSTAR LARVA TO X-RAYS. (abstr.) J. seric. Sci., Tokyo 21 (1952) 157. (In Japanese)

1232 Tazima, Y. COMPARATIVE STUDIES ON THE DIFFERENTIAL SENSITIVITY TO RADIATION OF SILKWORM GERM-CELLS AT DIFFERENT STAGES OF THE GAMETOGENESIS. I. Jap. J. Genet. 32, 8 (1957) 262-3. (Idengaku Zasshsi) (In Japanese)

* Tazima 1957 - [901]

1233 Tazima, Y. EFFECT OF EXTERNAL IRRADIATION WITH β-RAYS UPON THE GERM-CELLS OF THE SILKWORM. Mishima. Nat. Inst. Genet. Annu. Rep. 7 (1956, pub. 1957) 76-8. (In Japanese)

1234 Tazima, Y. GENIC CONTROL OF X-RAY SENSITIVITY OF SILKWORM GERM-CELLS. Mishma. Nat. Inst. Genet. Annu. Rep. 7 (1956, pub. 1957) 78-9. (In Japanese)

1235 Tazima, Y. CHANGES IN SENSITIVITY OF SILKWORM GERM CELLS TO X-RAYS WITH DEVELOPMENT. Radiation Res. 9 (1958) 193.

The sensitivity pattern of the germ cells to x-rays was studied by irradiating successive stages of gametogenesis in both sexes of the silkworm. The germ cells of this animal develop almost synchronously with the development of the parents, so that they may be estimated by the developmental stages of the parents. Wild type females and/or males were irradiated with 250-4000 r at several stages of the parents and were mated to non-irradiated partners; and the numbers of eggs laid, of unfertilized eggs, and of eggs that succumbed at several embryonic stages were recorded. Irradiation of the female 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. Incidence 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 mostly in early spermatocyte. Irradiation at other stages with the same dose was less deleterious, which indicates that the spermatogonium, 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.

(Abstract of paper presented at the Intern. Congr. of Radiation Res., Burlington, Vermont, 10-16 Aug. 1958)

1236 Tazima, Y. MUTATION RESPONSE PATTERN OF SILKWORM GERM CELLS TO X-RAYS. p. 291 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

The use of silkworms is advantageous for analyzing 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 parents in both male and female. X-irradiation was administered to male and female germ cells of silkworm at definite stages from larval instar to post-pupa at 250, 500, 1000, 2000, 3000 and 4000 r and mating was made to non-irradiated double recessive pe re partners. 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 spermatid stage; dominant lethals reached a maximum on the 2nd day of stadium 5, approximately at the spermatocyte 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 varieties of stages of oögenesis 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 spermatogonia and 10 times higher in mature sperms than corresponding Drosophila values. (from abstr.)

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

* Tazima 1959 - [1332]

* Telfer and Abrahamson 1954 - [1266]

* Terzian 1958 - [1153]

* Traut 1960 - [1074]

* Ulrich 1951 - [880], [881]

* Ulrich 1953 - [882]

* Ulrich 1955 - [883], [884]

* Ulrich 1956 - [885]

* Vasterling 1952 - [1423]

1237 Welshons, W.J., Russell, W.L. THE EFFECT OF X-RAYS ON THE DROSOPHILA TESTIS AND A METHOD FOR OBTAINING SPERMATOGONIAL MUTATION RATES. Proc. nat. Acad. Sci., Washington 43 (1957) 608-13.

Histological observations were made on the testes of irradiated adult Drosophila males. These experiments indicate that both secondary spermatogonia and young spermatocytes are sensitive to the killing effects of x-rays. The destruction of these sensitive cells results in a period of temporary sterility following irradiation of adult males. Therefore, this sterile period can be relied upon to separate cells irradiated as spermatogonia from those irradiated at a later spermatogenic stage. It follows that radiation-induced spermatogonial 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 1950 - [930]

* Whiting 1953 - [1424]

* Whiting 1954 - [1425]

* Whiting 1955 - [931]

* Whiting and Atwood 1955 - [1093]

* Whiting and Murphy 1955 - [1426]

* Whiting and Murphy 1956 - [1427]

* Witte and Sigmund 1952 - [1337]

* Yanders 1959 - [1338]

* Zirkle and Parrish 1950 - [852]

I-C-4 LETHAL EFFECTS

1238 **Арифов, У.А., Гуманский, Г.А., Клейн, Г.А., Пашинский, С.З., Щенков, С.Н. К ВОПРОСУ МОРКИ И КОНСЕРВАЦИИ КОКОНОВ ТУТОВОГО ШЕЛКОПРЯДА ГАММА-ЛУЧАМИ. Изв.Акад.наук Узб.ССР, Серия Физико-мат. наук 2 (1957) 65-72.**

Описаны опыты, проведенные с целью установления дозы гамма-облучения, необходимой для полного умерщвления куколок коконов тутового шелкопряда. Были отобраны куколки шелкопряда весенней выкормки (май-июнь) и подвергнуты облучению от источника Co-60 активностью 15 кюри. Смертельной дозой следует считать дозу не менее 340 000 р при данной мощности

дозы. Было также установлено, что при одинаковой дозе облучения скорее гибнут куколки зрелостью до 5 суток (при дозе 240 000 р), тогда как куколки в возрасте выше 5 суток гибнут при 340 000 р. Следует поэтому при облучении живых куколок различной зрелости применять дозу в 340 000 р. Кроме того, дальнейшее хранение коконов с умервщленными куколками в различных атмосферных условиях показало, что морка коконов гамма-лучами не только пастеризует их, но и делает вещество куколки неподходящей средой для развития микроорганизмов. Растворимость серецина облученных коконов несколько снижается: если у контроля (живые коконы) растворимость составляет 10,11%, то при облучении дозой в 340 000 р она - 8,80%, а при дозе в 740 000 р - 8,22%.

Arifov, U. A., Gumansky, G. A., Klein, G. A., Pashinsky, S. Z., Shchenkov, S. N. KILLING AND PRESERVING SILKWORM COCOONS BY γ-RAYS. Izv. Akad. Nauk Uzbek. SSR., Ser. fizikomatem. Nauk 2 (1957) 65-72.

Experiments were carried out to find the dose necessary for killing silkworm pupae at the cocoon stage. Spring (May-June) pupae were exposed to radiation from a 15 c Co^{60} source. The lethal dose was found to be < 340 000 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 240 000 r needing to be increased to 340 000 r for older pupae. For irradiating live pupae of different maturity a dose of 340 000 r should therefore be applied. Gamma-radiation used for killing the pupae was found not only to sterilize them but to make the pupal substance unsuitable for developing microorganisms. The solubility of sericin of irradiated cocoons decreased slightly: from 10. 11% of controls (live cocoons) the values dropped to 8. 80% after irradiation by 340 000 r, and 8. 22% after 740 000 r.

1239 Baker, V. H., Taboada, O., Wiant, D. LETHAL EFFECTS OF ELECTRONS ON INSECTS WHICH INFEST WHEAT AND FLOUR - PART I. Agric. Engng 34 (1953) 755-8.

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 10^5 rep sterilized eggs of the confused flour beetle and the granary weevil; the same dose prevented the adults from reproducing. A dose of 5×10^5 rep proved lethal to adults of both insects. Wheat was damaged by a dose of 10^5 rep which allowed it to germinate but inhibited further growth. A slight change was detected in the taste of bread made from irradiated flour.

1240 Baker, V. H., Taboada, O., Wiant, D. E. SOME EFFECTS OF ACCELERATED ELECTRONS OR CATHODE RAYS ON CERTAIN INSECTS AND ON THE WHEAT AND FLOUR THEY INFEST. I. Michigan Stage Coll., Agric. Exp. Sta., Quart. Bull. 36, 1 (1953) 94-106.

A Van de Graaff 2-MV electron accelerator was used to irradiate test lots of 50 adult granary weevils, Sitophilus granarius, in 9-cm petri dishes containing 30 g Cornell 595 wheat of 10% moisture content with various doses of accelerated electrons 3 d 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 rep sterilized flour beetle and granary weevil eggs and prevented adults from reproducing. Thirty percent of flour beetle eggs treated with 1000 rep hatched. A dose of 5×10^5 rep was lethal to 100% of flour beetles immediately after treatment, whereas a dose of 2.5×10^5 rep was lethal to 100% of adult granary weevils immediately after treatment. A dose of 2.5×10^5 was lethal to 92% of adult flour beetles 1 week after treatment; and a dose of 1×10^5 was lethal to 82% of adult granary weevils one week after treatment. Doses exceeding 10 000 rep were detrimental to wheat seed. Cornell 595 wheat and whole wheat flour were irradiated with a dose of 5×10^5 rep. Preliminary baking tests indicated a change in taste of bread, but was not undesirable. (auth.: D. E. W.)

1241 Baker, V. H., Taboada, O., Wiant, D. E. ELECTRON GUN AIMED AT INSECTS. Food Engng 26, 4 (1954) 64-6.

General article on the use of accelerated electrons from a Van de Graaff machine for disinfestation. For Tribolium adults 500 000 rep were lethal within a week, 250 000 rep sufficed for Sitophilus granarius. Egg sterility for both was ensured by 10 000 rep. The effects of irradiation on seed and baking quality, and on food value are discussed, also probable operating costs and production rate for possible future application of method. (See also Agric. Engng 34 (1953) 755, and 35 (1954) 407)

1242 Baker, V. H., Taboada, O., Wiant, D.E. SOME EFFECTS OF ACCELERATED ELECTRONS OR CATHODE RAYS ON CERTAIN INSECTS AND ON THE WHEAT AND FLOUR THEY INFEST. Michigan State Coll., Agric. Exp. Sta., Quart. Bull. 36, 4 (1954) 448-61.

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)

1243 Baker, V. H., Taboada, O., Wiant, D.E. LETHAL EFFECTS OF ELECTRONS ON INSECTS WHICH INFEST WHEAT, FLOUR, AND BEANS. - PART II. Agric. Engng 35 (1954) 407-10.

Further information on the effects of accelerated electrons on insects which infest wheat, flour (see Part I), 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, penetrations 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 are 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.

1244 Baldwin, W. F. SIMILARITIES IN KILLING BY HEAT AND BY X-RADIATION IN THE INSECT DAHLBOMINUS FUSCIPENNIS (ZETT.). Radiation Res. 5 (1956) 46-51.

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

(An earlier abstract was published in Radiation Res. 3 (1955) 213)

* Baldwin & Narraway 1957 - [1365]

* Baldwin & Narraway 1958 - [1366]

1245 Bletchly, J. D., Fisher, R. C. USE OF GAMMA RADIATION FOR THE DESTRUCTION OF WOOD-BORING INSECTS. Nature 179 (1957) 670.

Preliminary laboratory tests in Britain on the value of γ-ray treatment against wood-boring insects are summarized. Tests were carried out on Lyctus brunneus Steph., Anobium punctatum Deg. and Xestobium rufovillosum Deg. removed from wood or in samples approximately $\frac{1}{2}$ in thick. A Co^{60} 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 48 000 - 68 000 and over 32 000 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 48 000 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 timber containing both adults and larvae could most effectively be irradiated. Further work with this species is in progress.

1246 Bletchly, J. D. SOME LABORATORY INVESTIGATIONS ON THE ERADICTION OF WOOD-BORING INSECTS BY GAMMA RADIATION. p. 385-9 in "Proceedings of the 10th International Congress on Entomology, Montreal 17-25 Aug. 1956", Vol. 4. Becker, E. C., ed. Ottawa, Mortimer Ltd. 1958.

Work is described on Xestobium rufovillosum Deg., Anobium punctatum Deg. and Lyctus brunneus Steph., the last being easily reared in the laboratory. A Co^{60} source was used, irradiation ranging from 50 r/min

to 1200 and 1300 r/min. The effective lethal dosages required for the different stages of the life cycle may be summarized 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 dosages of 8000 r (Lyctus), 6000 r and over (Anobium). Pupae: 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). It is thought that females are more resistant (Lyctus). The use of γ-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 dosages.

1247 Colombo, G. THE LETHAL EFFECTS OF X-RAYS ON OÖCYTES OF THE SILKWORM (BOMBYX MORI L., LEPIDOPTERA). Caryologia 11, 3 (1959) 273-96. (In Italian, summary in English)

* Cornwell et al. 1957 - [1113]

1248 Courtois, G., Lecomte, J. SUR LA RÉSISTANCE AU RAYONNEMENT GAMMA DE L'ABEILLE OUVRIÈRE. Ann. abeille 4 (1959) 285-90.

L'Abeille butineuse irradiée par le rayonnement gamma issu d'une source de Cobalt 60 supporte sans dommages apparents une dose de 18 000 r. Des dommages très appréciables sont observés pour 90 000 r. Une dose de 200 000 r entraîne la mort immédiate de 100% des individus. L'état physiologique de l'Abeille joue un rôle important dans la résistance au rayonnement gamma.

(Also published as report CEA-1377, Commissariat à l'Energie Atomique, Paris)

1249 Cember, H. THE LETHAL RADIATION EFFECTS OF X-RAYS AND FAST NEUTRONS ON THE EMBRYO OF THE AMERICAN COCKROACH. M.S. Thesis. University of Pittsburgh, Pittsburgh, Pa. 1952.

* Davich and Lindquist 1959 - [1115]

1250 Egli, H. DIE EMBRYONALE STERBLICHKEIT BEI DROSOPHILA NACH BESTRAHLUNG IN LUFT, REINER STICKSTOFF- UND REINER SAUERSTOFFATMOSPHÄRE (Embryo mortality in Drosophila following irradiation in air, pure nitrogen and pure oxygen respectively). Doctoral Diss. Zürich, Switzerland. 1956, 19p. (In German)

0-24 h-old Drosophila males were irradiated in air, pure N_2 or pure O_2, dosed at 101.6 r/min, with a total dose = 2000 r. The radiosensitivity to x-rays of the various stages of spermatogenesis was observed, damage being measured in terms of embryonic mortality of the offspring of irradiated males, followed for 14 d. Between the 5th-11th d post-irradiation, the hatching rate dropped rapidly, i.e. spermatids which develop to mature sperm at that time are particularly radiosensitive. When N_2 is added during irradiation, radiation damage is clearly less than in air. Irradiation in pure O_2 as compared with air increases mortality already during the first few days. Mature sperm were also damaged more when O_2 was added. In no case could aspermia be established 8 - 9 d post-irradiation. Results were checked by the t-test.

* Erdman 1960 - [867]

* Frey 1952 - [821]

* Fritz-Niggli 1956 - [823]

1251 Hannan, R.S. ELECTRONIC STERILIZATION OF FOODS. Research 6 (1953) 376-83.

A summary is given of the basic facts emerging from work done on electronic sterilization of foods. High-energy electrons and γ-rays from radioactive sources were used. Some information on the dosages necessary for destroying bacteria, and insects and their eggs are given. Whereas γ-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 (1954) 338, no. 1947)

1252 Hassett, C. C., Jenkins, D. W. USE OF FISSION PRODUCTS FOR INSECT CONTROL. Nucleonics 10, 12 (1952) 42-6.

Lethal doses of high energy γ-radiation were studied for 8 species of insect pests of food, clothing, wood and other stored products. Doses of 1300 r/h from a Ta^{182} source and 193 000 r/h from a Co^{60} 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 susceptibility to radiation. Dose mortality curves and mortality are given for Attagenus piceus, Dermestes ater, Lasioderma serricorne, Sitophilus oryza, Rhyzopertha dominica, Tribolium confusum, Lyctus planicollis, Drosophila melanogaster. While susceptibility of species varied, doses in excess of 20 000 r were required to produce deaths. Probable dose for insect destruction is of the order of 10^5 r; fast-killing doses (65 000 r) can be used to stop damage by heavy infestations, lower doses to prevent reproduction. Lyctus showed peculiarity in that high doses were extremely depressive for the first two days, radiation having the effect of temporary knockdown. 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.)

1253 Hassett, C. C. LETHAL RADIATION FOR STORED PRODUCTS INSECTS. Pest Control 25, 11 (1957) 13-4.

A brief informative survey of work on the effects of various doses of γ-rays on 6 insect species (adults of Lasioderma, Sitophilus, Attagenus, Tribolium and Rhyzopertha, and on larvae and adults of Dermestes). Various processing units and sources of radiation are mentioned, and some cost estimates given.

1254 Heidenthal, G., Clark, L. B. SURVIVAL RATES OF HABROBRACON EGGS TREATED IN FIRST MEIOTIC METAPHASE WITH LOW AND HIGH VOLTAGE X-RADIATION. (abstr.) Genetics 36 (1951) 554.

Studies were made on the survival of haploid eggs treated in first meiotic metaphase with low voltage (124 kV) and with high voltage (50 MeV) x-radiation. Dosage ranged from 100 r 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 54% for high voltage and 51% for low; at 1500 r the viability was about 5% 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 voltage but laid by females which were mated following irradiation. Under these conditions it would be expected that if recessive lethals were present, viability should increase. Since the curves for eggs from mated and from unmated females are so very nearly alike, it is tentatively concluded that death of eggs is to be attributed to dominant lethals.

* Jefferies & Cornwell 1958 - [1144]

* Kenworthy 1956 - [1394]

* King 1953 - [389]

* King 1954 - [390]

* King and Wilson 1955 - [1319]

1255 Кипиани, Р.Я., Цецхладзе, Т.В. ЗАМОРИВАНИЕ КУКОЛОК И КОНСЕРВАЦИЯ КОКОНОВ ТУТОВОГО ШЕЛКОПРЯДА ГАММА-ИЗЛУЧЕНИЕМ. Сообщ.Акад.наук Груз.ССР 17, 7 (1956) 657-62.

Куколки тутового шелкопряда поддаются гамма-лучевой заморке. Куколки разной выкормки характеризуются различной устойчивостью к гамма-излучению. 100% летальные дозы составляют: для I-й выкормки 200 000 фэр, для II-й выкормки 150-180 000 фэр, для III-й выкормки 100 000 фэр. После получения летальной дозы куколки постепенно перестают реагировать на внешнее воздействие, со временем темнеют и уменьшаются в весе. Имеется прямая зависимость между потерей в весе и дозой. Гамма-излучение вызывает затягивание фазы развития куколки на незначительное время, что не может иметь практического значения. На основании наблюдений над облученными коконами в течение 5 месяцев можно предположить, что летальная доза 200 000 фэр является также и консервационной.

Kipiani, R.Ya., Tsetskhladze, T. V. THE KILLING OF SILKWORM PUPAE AND THE PRESERVATION OF SILKWORM COCOONS BY GAMMA-RAYS. Soobshch. Akad. Nauk Gruz. SSR 17, 7 (1956) 657-62.

Silkworm pupae are susceptible to γ-radiation. Pupae produced in different seasons are characterized by different resistances to γ-rays, the lethal dose (LD_{100}) requiring 200 000 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 5 months suggest that a lethal dose of 200 000 rep also ensures preservation.

1256 Langendorff, H., Sommer, K. DIE ABTÖTUNG VON DROSOPHILA-EIERN DURCH ENERGIEREICHE STRAHLEN ALS BIOPHYSIKALISCHES PROBLEM (The killing of Drosophila eggs by high-energy radiation, treated as a biophysical problem). Strahlentherapie 82 (1950) 316-20. (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 4h-old eggs. Results pointed to a high degree of variability in younger (above ½ h-old) stages of egg development, and proved that many elementary ray hits were required for the killing action. Irradiation with grenz-rays showed that the damaged part of an egg is comparatively large relative to the egg volume.

1257 Lauffer, M. A., Cember, H. THE LETHAL RADIATION EFFECTS OF X-RAYS AND FAST NEUTRONS ON THE EMBRYO OF THE AMERICAN COCKROACH (PERIPLANETA AMERICANA). (abstr.) Biol. Bull. 109 (1955) 336.

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 0.563 Å, and also with fast neutrons of energies between 2 and 10 MeV. X-ray doses varied between 25 and 5000 r and dose rates between 25 and 100 r/min; neutron doses between 41 and 4426 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. The effects were independent of λ and dose rate. (from abstr.)

1258 Lee, W. R., Jr. RADIATION INDUCED DOMINANT LETHAL MUTATIONS IN THE HONEYBEE. Ph. D. Thesis. Wisconsin Univ., Madison. Univ. Microfilm, Ann Arbor, Mich. Publication No. 18420 (1956).

This thesis was published in Genetics, see under Lee, W. R. 1958. An outline of this paper is published in the Abstracts of the Genetics Society of America, 1956, no. 25, see under Lee, W. R. 1956.

* Lee 1956 - [1019]

* Lee 1958 - [1020]

1259 Limbaugh, B., Gaulden, M. E. THE LETHAL EFFECTS OF X-RAYS ON THE NEUROBLASTS AND EMBRYOS OF THE GRASSHOPPER, CHORTOPHAGA VIRIDIFASCIATA. (abstr.) ASB Bulletin 4, 1 (1957) 14.

Embryo LD_{50} (30 d) was found at 400 - 450 r; LD_{100} (33 d) at ~ 600 r. For 600 - 17 000 r decreasing development with subsequent deterioration were observed. Neuroblasts recovered from mitotic inhibition (after 500 - 2000 r) divided at approximately the same rate as cells in unirradiated embryos. The neuroblasts were fairly "resistant" to permanent inhibition.

Abstract of paper presented at the 18th Annual Meeting of the Association of South-Eastern Biologists, Athens, Ga. 18-20 Apr. 1957.

1260 Mortreuil, M. ACTION LÉTHALE DES RAYONS X SUR CALANDRA GRANARIA L. C. R. Soc. Biol., Paris 153 (1959) 393-4.

Jusqu'à la dose de 2000 r, les rayons X n'induisent aucun effect léthal chez Calandra granaria L. irradié à l'état adulte. Au delà et jusqu'à 25 000 r, la survie moyenne des populations reste la même quelle que soit la dose reçue. Les irradiations supérieures à 25 000 r provoquent une mortalité de plus en plus rapide des Insectes. On note une inhibition irréversible de l'appareil reproducteur. Il semble y avoir aussi des modifications de l'appareil digestif et du système nerveux.

1261 Muller, H. J. THE CHROMOSOMAL BASIS OF THE MORTALITY INDUCED BY X-RAYS IN DROSOPHILA. p. 321-5 in "Immediate and Low Level Effects of Ionizing Radiations. Proceedings of the Symposium at Venice 22-26 June 1959". Buzzati-Traverso, A. A., ed. London.

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: 3948 (1961))

* Rogers and Borstel 1957 - [922]

* Rogers and Hilchey 1960 - [1343]

* Schinz et al. 1952 - [1228]

1262 Seto, F. TIME OF ACTION OF A SERIES OF RECESSIVE LETHAL FACTORS IN DROSOPHILA MELANOGASTER. J. exp. Zool. 126 (1954) 17-32.

Time of action studies were made on eggs, larvae, pupae and adults. Lethal effects were studied on natural poplations, populations raised in the laboratory, and others subjected to x-rays. Lethal effects were found to be selective, depending on the stage under investigation. The 7 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), 10-egg larval (E/L), 16 larval (L), 6 larval-pupal (L/P), and 6 pupal lethals (P). The distribution of the x-ray induced lethals was: 7 E, 5 E/L, 12 L, 1 L/P and 2 P. These data, though showing no significant differences by themselves, when combined with similar data from Rizki 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 10 pupal lethals is given.

1263 Steger, R. EMBRYONALE STERBLICHKEIT DER NACHKOMMEN VON MÄNNLICHEN DROSOPHILA-FLIEGEN NACH BESTRAHLUNG MIT 180 keV UND 31 MeV (Embryo mortality among the progeny of male Drosophila flies following irradiation with 180 keV and 31 MeV). AEC-tr-3340, translated for Los Alamos Scientific Lab. from Oncologia 9 (1956) 12-32. (In German)

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 unmated females and a count made of the ratio of hatched to unhatched eggs which resulted. A total of 94389 eggs were counted. It is suggested that the enormous increase of unhatched eggs between days 6 and 12 may not have resulted from lethal factors, but from azoöspermia induced by radiation. The 31 MeV betatron was shown to be only 0.8 times as effective as the stable voltage generator in producing dominant lethal factors. (NSA 12: 16088, 1958)

1264 Sugahara, T., Horikawa, M. TISSUE CULTURE ANALYSIS OF DELAYED LETHAL IRRADIATION EFFECT IN D. MELANOGASTER. Mishima. Nat. Inst. Genet. Ann. Rep. 8 (1957, pub. 1958) 75-6.

1265 Sumarokov, G. V. THE DYNAMIC RADIATION INJURY IN CALANDRA GRANARIA UNDER VARIOUS IRRADIATION CONDITIONS. Biophysics (USSR) (English Translation) 3 (1958) 359-61.

The effects of ionizing radiation on adult insects were studied following the exposure of the beetle, Calandra granaria, during the developing stage to various doses of Co^{60} 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 summarized from three repeated tests in which 25000 insects were used. (NSA 13: 9579, 1959)

1266 Telfer, J. D., Abrahamson, S. THE HIGHER EGG MORTALITY ASSOCIATED WITH INSEMINATION ON THE FIRST THAN THE SECOND DAY AFTER IRRADIATION OF DROSOPHILA MALES. (abstr.) Genetics 39 (1954) 998-9.

Egg mortality was compared following ejaculation of D. melanogaster sperm 0-24 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 "overripeness" if the males were not allowed to mate before irradiation. (from auth.)

* Tsetskhladze et al. 1957 - [1559]

* Whiting and Atwood 1955 - [1093]

1267 Whiting, A. R., Caspari, S. B., Koukides, M., Kao, P. STAGES OF DEATH OF X-RAY-INDUCED EMBRYO LETHALS IN HAPLOIDS AND IN HETEROZYGOTES OF HABROBRACON. Radiation Res. 8, 2 (1958) 195-202.

This study demonstrated that, for x-ray-induced embryo lethals, dominants in haploids, dominants in heterozygotes, and recessives in haploids kill at increasingly later stages, respectively; and haploid embryos 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 oöcytes or of spermatozoa. In oöcytes x-ray-induced lethality appears to be due to recessive lethals sensu stricto, and there is no correlation between number of lethals present in an embryo and its stage at death, and no cumulative effect. In spermatozoa 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 these additional factors. (auth.)

* Woestijne and Brande 1960 - [1298]

1268 Yanders, A. F. RELATIVE TIME OF ECLOSION OF DROSOPHILA FEMALES HETEROZYGOUS FOR SEX-LINKED RECESSIVE LETHALS. USNRDL-TR-216 Naval Radiological Defense Lab., San Francisco. 1958, 15 p.

Male Drosophila melanogaster (Oregon-R) were irradiated with 3200 r of 1.6 MeV electrons and mated to Muller-5 females. The eclosing F_1 female progeny were collected at 12-h 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 leads to the equation $\hat{Y} = 5.342 + 1.338\,X$, where $\hat{Y}$ is the expected percentage of lethals and X is the sequential 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

1269 Hilchey, J. D. ACTION OF IONIZING RADIATIONS ON INSECTS (chapter 25) p. 240 - 66 of "Radiation Preservation of Food" The US Army Quartermaster Corps, US Off. Tech. Serv., 1958.

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, comparative biological effectiveness, and radiation disinfestation. 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 disinfestation of foods" was published in Bull. ent. Soc. Amer. 2, 3 (1956) 26, abstr. 10)

1270 Baxter, R. C., Tuttle, L. W. LIFESPAN SHORTENING IN IRRADIATED DROSOPHILA MELANOGASTER. Radiation Res. 7, 3 (1957) 303.

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 imagoes were given single treatments with doses ranging up to 225 kr of Co^{60} 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 controls, 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 25 d were given a single dose of 75 kr. There was no increase in radio-

sensitivity 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 fractionations of the same total doses commencing on their first day and ending on the tenth 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 Res. Soc., Rochester, N.Y., 13-15 May 1957)

1271 Bochnig, V., Lüers, H., Winterfeld, G. DIE MITTLERE LEBENSDAUER VON DROSOPHILA MELANOGASTER NACH EINMALIGER RÖNTGENBESTRAHLUNG MIT HOHEN DOSEN (The average life span of Drosophila melanogaster after a single irradiation at high dosage). Zool. Beitr. Berl. 5, 2/3 (1960) 367-72. (In German)

"Berlin-wild" strain of D. melanogaster aged 24 - 48 h were subjected to 40 000 r, 70 000 r and 100 000 r. The techniques used are described. 11 600 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 much 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 LD_{50} is 75 000 r for the female, and 30 000 r for the male.

1272 Burger, C. L., Jr. BIOLOGICAL EFFECTS OF X-RAYS ON PARTIALLY IRRADIATED LARVAE OF A BAR-EYED RACE OF DROSOPHILA MELANOGASTER MEIGEN. Diss. Abstr. 19, 12 (1959) 3418.

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 totals, anteriors, and posteriors with regard to facet number are significant only in the females when an analysis of variance test is used, but the test is presumed invalid since the group tested (survivors) was no longer randomly distributed. 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 noted in all experimental groups but not in controls, with regard to eye facet number. Standard errors in experimental categories are uniformly > 1, while control categories show 0.53 for ♀ and 0.65 for ♂. (from abstr.)

1273 Clark, A. M. SOME EFFECTS OF X-RAYS ON LONGEVITY IN HABROBRACON FEMALES. TID-6053, Delaware, Univ., Newark and Oak Ridge National Lab., Tenn. (1958) 21 p.

Habrobracon females when exposed to x-rays as larvae, pupae, or adults show a decrease in adult life span which is shortened 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 200 000 r, as little as 5000 r causes a reduction in life span. (auth.)

* Clark 1960 - [862]

1274 Clark, A. M. THE MODIFICATION OF LIFE SPAN BY X-RAYS FOR HAPLOIDS AND DIPLOIDS OF THE WASP, HABROBRACON SP. Biol. Bull. 119 (1960) 292.

Haploid males, diploid males and diploid females of the wasp, Habrobracon sp. (an Indian species related to Habrobracon juglandis), show a decrease in adult life span following exposure to x-rays as larvae-in-cocoons, white pupae or adults. The median life span for non-irradiated adults was 62 d for haploid males and diploid males fed on honey-water, 92 d for diploid females fed on honey-water and 40 d for diploid females fed on larvae of the Mediterranean flour moth, Ephestia. 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 10 000 - 50 000 r have a shorter life span than comparable diploid males. Diploid males and diploid females show similar decreases in life span relative to their controls. Pupae after exposure to 10 000 and 15 000 r and larvae after exposure to 2000 r are equal to 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.

1275 Cork, J. M. GAMMA-RADIATION AND LONGEVITY OF THE FLOUR BEETLE. Radiation Res. 7 (1957) 551-7.

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 3000 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.

1276 Dent, J. N., Amy, R. L. DEVELOPMENTAL EFFECTS OBSERVED IN HABROBRACON AFTER EXPOSURE TO BETA RADIATION. Growth 14 (1950) 113-21.

Developing individuals of H. juglandis 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 inverse correlation between the extent of imaginal differentiation 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. (auth.)

* Erdman 1960 - [868]

* Grosch 1956 - [1313]

* Gowen and Umaerus 1958 - [945]

1277 Grosch, D. S. INDUCED LETHARGY AND THE RADIATION CONTROL OF INSECTS. J. econ. Ent. 49, 5 (1956) 629-31.

The longevity of heavily irradiated (50 000 - 180 000 r) female wasps (Habrobracon) was determined in the presence of food (pre-stung host 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 ~ 100 000 r, and is explained by the inactivity of the treated insects. This lethargy is induced at a much lower dose than that required to cause prompt adult death but exceeds dose levels which sterilize adults and kill all immature stages. Therefore, if the presence of adult insects is not objectionable, the induction of non-feeding lethargy may be a more feasible technical approach to insect control than quick-killing exposures. It seems likely that the nervous system may be more sensitive to irradiation than has been deduced from morphological studies. (from auth.)

1278 Howden, H. F., Auerbach, S. I. SOME EFFECTS OF GAMMA RADIATION OF TROGODERMA STERNALE JAYNE. Ann. ent. Soc. Amer. 51, 1 (1958) 48-51.

Some aspects of the biology of T. sternale and the effects of single and fractionated doses of γ-radiation (from Co^{60}) 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 vitality 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)

1279 Ito, T., Tanaka, M. EFFECT OF RADIATION ON THE GROWTH OF SILKWORM LARVAE. J. Sericult. Sci., Tokyo 28, 4 (1959) 220-6. (In Japanese)

* Ives et al. 1959 - [892]

* Kenworthy 1954 - [1393]

1280 Kroeger, H. EINE ANALYSE RÖNTGENINDUZIERTER MODIFIKATIONEN IM FLÜGELGEÄDER DER MEHLMOTTE EPHESTIA KÜHNIELLA ZELLER (An analysis of x-ray-induced modifications in the vein pattern in the wings of the flour moth Ephestia kühniella Zeller). Roux Arch. EngwMech. Organ. 150, 1 (1957) 77-104. (In German)

Abnormalities in the system of veins in the wings are examined, induced by x-radiation in the last larval stage. There are 2 types of modifications: (i) additional veins arise in the form of links between longitudinal veins, as a splitting up near the edge or as local eye-like doubling. They originate during the first 5 d of that larval stage and are accompanied by shorter and wider wings; (ii) reduction of veins results from localized merging of two longitudinal veins, which usually happens between the 6th and 9th d, when the wings are usually smaller than in the control. On the 5th d of the last larval stage when the trachae grow into the wing there is a change in metabolism accompanied by low radiosensitivity. The primary result of irradiation is disturbances in mitosis. The less shapely form of the wing is due to disorder in spindle directions. The wider significance of the results is discussed.

1281 LaChance, L.E. INGESTION OF ETHYLENEDIAMINETETRAACETIC ACID AND THE EFFECT ON LIFE SPAN OF IRRADIATED AND CONTROL HABROBRACON FEMALES. Nature 182, 4639 (1958) 870-1.

A number of experiments were carried out on the genetic damage induced in the reproductive tissues of Habrobracon females by chelating agents and x-irradiation. X-rays alone had no effect on the reduction of life span below that of the controls, whereas feeding with ethylenediaminetetraacetic acid had. Ingested ethylenediaminetetraacetic acid enhances the radiation effect when fertility or dominant lethals are the criterion of damage, but the combination of treatments does not shorten the life span in a synergistic manner.

1282 Lamarque, P. STUDY OF RECOVERY AFTER IRRADIATION WITH X-RAYS. J. Chim. Phys. 48 (1951) 252-5.

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-h interval the optimal recovery is observed when the ratio between the first partial dose and the total dose is equal to $\frac{2}{3}$. Recovery processes are ascribed to metabolic activities of the cell. (NSA 5: 5482, 1951)

1283 Lamarque, P. LA RESTAURATION EN RADIOBIOLOGIE. Pr. méd. 60 (1952) 1039-41.

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. (NSA 7: 1884, 1953)

* Lamarque and Gary-Bobo 1956 - [838]

1284 Larsen, W.P., Grundmann, A.W. THE EFFECTS OF X-IRRADIATION ON THE EMBRYOS OF THE COCKROACH, BLABERUS CRANIIFER. Proc. Utah Acad. Sci., Arts and Let. 37 (1960) 51-2.

Gravid cockroaches containing developing embryos from 1 to 60 d old were given x-ray dosages varying from 50 to 1000 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.

1285 Lüning, K. G., Hannerz, B. RECOVERY PHENOMENON AFTER IRRADIATION IN DROSOPHILA MELANOGASTER. I. RECOVERY OR DIFFERENTIAL SENSITIVITY TO X-RAYS. Hereditas 43, 3-4 (1952) 549-62.

Differential sensitivity versus recovery are the two hypotheses proposed to explain the effect of O_2 concentration as well as the influence of the mating period on the rate of x-ray induced chromosome aberrations. The results obtained from rod versus ring chromosomes were not conclusive as regards the O_2 effect but indicate that the difference between the mating periods was due to recovery. Studies with fractionated irradiation (at 15-min intervals) in air or at anoxia indicated that the same rate of primary chromosome breaks is induced but that when the whole treatment is at anoxia there is a certain rate of recovery. This was, in part, based on the fact that when half of the treatments was given at anoxia and the other in air the result was the same as when both fractions were given in air (each fraction being 1620 r). This dose, in air, was sufficient to block the recovery process. The implications are discussed.

1286 Lüning, K. G., Henze, A. THE RECOVERY PHENOMENON AFTER IRRADIATION IN DROSOPHILA MELANOGASTER. III. THE INACTIVATION DOSE OF THE RECOVERY PROCESS. Hereditas 43, 3-4 (1957) 571-7.

When a total dose of 6840 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 540 r are applied under the same conditions, the rest being given in a N_2 atmosphere. The form of the curve indicates that inactivation is the result of multiple hits.

1287 Lüning, K. G., Söderström, J. RECOVERY PHENOMENA AFTER IRRADIATION IN DROSOPHILA MELANOGASTER. II. RECOVERY OF RECESSIVE LETHALS. Hereditas 43, 3-4 (1957) 563-70.

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 Halle (1953, 1955). (cf. confirmation by Lüning and Hannerz, 1957).

1288 Lüning, K. G. RECOVERY PHENOMENON AFTER IRRADIATION IN DROSOPHILA MELANOGASTER. IV. SPONTANEOUS RECOVERY OF IRRADIATED CHROMOSOMES VERSUS DIFFERENTIAL SENSITIVITY. Hereditas 44, 1 (1958) 161-8.

Data is presented which still further strengthens the hypothesis of a spontaneous recovery process in sperm irradiated in air. The hypothesis of differential sensitivity in various stages of spermiogenesis was re-investigated. The same technique was used as in the establishment of the spontaneous recovery process, i.e. eliminations of X- and Y-chromosomes in sperm from X^{C2}; sc^8Y males. It is concluded that the high rate of chromosome aberrations induced in stages supposed to be spermatids was due to a greater sensitivity. Furthermore it is shown that the sensitivity in these stages depended on the age of the males at treatment. Hence, the co-existence of a spontaneous recovery and of differential sensitivity in spermiogenesis in Drosophila has been demonstrated.

1289 Lüning, K. G., Schuwert, B., Jonsson, S. THE RECOVERY PHENOMENON AFTER IRRADIATION IN DROSOPHILA MELANOGASTER. V. THE RELATION OF VIABILITY MUTATIONS TO BREAKAGE OF CHROMOSOMES. Hereditas 44, 1 (1958) 169-73.

Males (w) 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.

1290 Lüning, K. G., Hendriksson, H. O. RECOVERABLE LETHAL MUTATIONS IN DROSOPHILA SPERM. Nature 183, 4669 (1959) 1211-2.

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 obtained for the recovery of potential recessive lethals which occurred between 30 and 40 min after irradiation, and is similar to that obtained for chromosome breaks.

1291 Mizell, F. M. SOME BIOLOGICAL EFFECTS OF RADIATION ON INSECTS. Ohio State Univ. Abstr. Doct. Diss. 66 (1954) 269-70.

Tests on Blattella germanica, Tribolium confusum, and Prodenia eridania.

1292 Moriwaki, D., Tobari, I. THE GENETIC EFFECTS OF RADIATION ON THE LONGEVITY OF PROGENY IN DROSOPHILA MELANOGASTER. J. Radiation Res. (Japan) 1 (1960) 14-22.

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 lives of the male offspring of these irradiated parents were significantly shorter than those of the controls. The female 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 males. The male offspring seemed to be more strongly affected by irradiation 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.)

1293 Moriwaki, D., Yoshida, Y. H., Tobari, I., Kirimura, N. SURVIVAL RATES OF PROGENY OF IRRADIATED DROSOPHILA MELANOGASTER. Radiation Res. 9 (1958) 155.

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 2800 r of x-rays and mated with virgin 3- or 4-d-old females. The progeny were examined by counting daily the number of surviving adult flies until all had died. In another experiment, the progeny raised from the mating of irradiated females (900 r) with nontreated 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.

(Abstract of paper presented at the Intern. Congr. of Radiation Res., Burlington, Vermont 10-16 Aug. 1958)

1294 Schneiderman, H. A., Weinstein, J., Horwitz, J. RECOVERY OF DIAPAUSING LARVAE OF A CHALCID WASP (NASONIA VITRIPENNIS) FROM X-IRRADIATION. Anat. Record 128, 3 (1957), 618-9, abstr. 219.

Diapausing larvae Mormoniella vitripennis provide an opportunity to study recovery from x-irradiation uncomplicated by cell division because during diapause all mitotic activity ceases, although metabolism continues. Diapause is terminated and cell division initiated by chilling larvae and then placing them at 25°C, whereupon pupation and adult development begin. In the present study diapausing 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 diapause. Following this, they were returned to 25°C and their development observed. The results revealed considerable post-irradiation recovery. For example, of larvae given 4000 r and immediately chilled, only 8% pupated. A post-irradiation recovery period of 5.5 h at 25°C enabled 55% to pupate, while a 10-d recovery period permitted 87% to pupate. These results were confirmed by split dose experiments in which it was shown that recovery took place between doses. The data demonstrate a marked and prolonged post-irradiation recovery in the non-dividing cells of the diapausing larva.

1295 Sullivan, R. L., Grosch, D. S. THE RADIATION TOLERANCE OF AN ADULT WASP. Nucleonics 11, 3 (1953) 21-3.

The effects of various x-ray dosages and ingested P^{32} on the parasitic wasp Habrobracon were investigated. X-ray dosages of less than 108 150 r produced no visible effects, and 144 200 to 180 250 r caused sluggishness from which recovery was noted in about 30 min. Actually, both males and females showed increased life span following x-irradiation. The life span was not demonstrably affected by P^{32} ingestions of 100 and 250 $\mu c/cm^3$ 15 references. (NSA 7: 2467, 1953)

1296 Sullivan, W. N., Smith, C. N. EXPOSURE OF HOUSE FLIES AND ORIENTAL RAT FLEAS ON A HIGH ALTITUDE BALOON FLIGHT. J. econ. Ent. 53 (1960) 247-8.

Houseflies (Musca domestica L.) and oriental rat fleas (Xenopsylla cheopis (Rothsch.)) were exposed inside an air-conditioned gondola during a balloon flight that maintained an altitude of 78 000 to 82 000 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. Succeeding generations of the exposed insects

reproduced about normally and no physical abnormalities were noted. Fleas exposed outside the gondola were killed by the low temperature. (auth.)

1297 Tracey, Sr., K. M., Jakowska, S., Fodor, V. M. THE EFFECTS OF X-RADIATION ON THE LIFE CYCLE OF TENEBRIO MOLITOR. (abstr.) Radiation Res. 11, 3(1959) 473.

Whole-body x-radiation in a single dose of 50 or 300 r was administered to 6th instar larvae, newly formed pupae, and newly hatched adults, in groups of 50 animals each (140 kV, 20 mA, 5 mm Al, 0.3 mm Cu, dose rate 47 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 as either larvae or early pupae was shortened to 3 to 5 d instead of the usual 5 to 8 d; the last larval and prepupal stage was also shortened. The cystine-cysteine complex was missing in the free amino acid chromatograms of irradiated larvae; hence the irradiated animals resembled the larvae produced by old parents. X-irradiation 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 6 d, whereas normally the black body is formed in 48 h. During this period the exoskeleton remained soft, since scleratinization 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)

1298 Van de Woestijne, N., Van den Brande, J. RESISTANCE DES INSECTES AUX IRRADIATIONS IONISANTES. QUELQUES RESULTATS AVEC LA TEIGNE DE LA FARINE, EPHESTIA KUEHNIELLA Z. Bull. Inst. agron. Gembloux hors sér. 2 (1960) 872-82.

Eggs, larvae and pupae were exposed to gamma rays from a Co^{60} source. Doses below 4500 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 4500 rad gave rise to adults; emergence of these was delayed by two days, they were deformed and sluggish and few reproduced. Increasing the dose to 9000 rad reduced the percentage of adults to 5.7 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 18 000 rad both eggs and larvae were killed. When pupae received doses of 4500 and 9000 rad, the resulting adults were scarcely affected, but the numbers of F_1 larvae produced were reduced by about 60 and 80% respectively. A few adults emerged from pupae that received a dose of 18 000 rad, but they were unable to breed.

* Wharton & Wharton 1959 - [887]

1299 Yagi, N. SEXUAL MARK VARIATION IN MALE AND FEMALE PIERIS RAPAE PTERIN-PROTEIN COMPLEX BY FEEDING WITH Ca^{45} AND RADIUM γ-RAY IRRADIATION. Dai-2-kai Genshiryoku Shimpojiuma Hobunshu 4 (1958) 218-21.

The pterin-protein body in scales of P. rapae was granular in the male, while needlelike in the female. Irradiation by γ-rays from Ra at the wing-forming stage of the butterfly reduced this difference and produced anomalous shapes in both sexes by heavy doses. Feeding pupae of this butterfly on cabbage supplemented by Ca^{45} also reduced the difference in the pterin-protein body shape in both sexes.

I-C-6 PHYSIOLOGICAL AND BIOCHEMICAL EFFECTS

* Amy 1955 - [810],[811]

1300 Baldwin, W. F., Salthouse, T. N. LATENT RADIATION DAMAGE IN THE BODY WALL OF THE INSECT RHODNIUS PROLIXUS. Radiation Res. 9 (1958) 89.

Cell division preparatory to molting takes place during a fixed period after feeding in the epidermis of the blood-sucking bug Rhodnius prolixus; 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 mm beam of 2 MeV x-rays (dose 50 000 r), the development of the epidermal layer is quite normal during the first 5 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 degradation begins on the 9th and 10th days. The "burned" area is eventually covered by an undifferentiated

chitin-protein layer secreted by epidermal cells migrating from the periphery of the "burn". The latent injury to the cells is permanent, and overt "burns" have been produced when feeding has been delayed for periods as long as three months after the irradiation. Also, the "burns" always reappear when the insects are induced to molt a second time. The latter effect can be attributed to the absence of specialized cells (oenocytes), which are required to form the outside epicuticular layer.

(Abstract of paper presented at the International Congress of Radiation Research, Burlington, Vermont, 10-16 Aug. 1958)

1301 Baldwin, W. F., Salthouse, T. N. LATENT RADIATION DAMAGE AND SYNCHRONOUS CELL DIVISION IN THE EPIDERMIS OF AN INSECT. I. NONREVERSIBLE EFFECTS LEADING TO LOCAL RADIATION BURNS. Radiation Res. 10 (1959) 387-96.

In the bloodsucking insect Rhodnius prolixus, cell division preparatory to molting takes place in the nymphal epidermis only during a fixed period after a meal of blood. Since feeding determines the time of mitosis in the epidermis, this insects serves as a good subject for studies of latent radiation damage. Results are presented from a study in which latent radiation damage in the epidermal layer was converted into visible burns after a blood meal. Photographs of histological studies and a timetable of events during development of latent radiation damage are included. (NSA 13: 10809, 1959)

1302 Baldwin, W. F., Salthouse, T. N. LATENT RADIATION DAMAGE AND SYNCHRONOUS CELL DIVISION IN THE EPIDERMIS OF AN INSECT. II. REVERSIBLE EFFECTS IN BURN REPAIR. Radiation Res. 10 (1959) 397-9.

The time required for healing and molting in irradiated nymphs of the bloodsucking insect Rhodnius prolixus can be reduced almost to normal if they are given a period in which to recover from some of the effects of irradiation before being fed. (NSA 13: 10810, 1959)

1303 Bourgin, R. C., Krumins, R., Quastler, H. RADIATION-INDUCED DELAY OF PUPATION IN DROSOPHILA. Radiation Res. 5, 6 (1956) 657-73.

X-irradiation induces pupation delay in D. melanogaster. A given dose causes the same delay, regardless of larvae age at the time of irradiation (within wide limits). Fractional irradiation established that the target zone for the induction of delay lies in the anterior third of the body; presumably, the ring gland is the target organ. The effect is not a simple delay; instead, an abnormal phase occurs between the time when a larva would normally pupate and the time when it actually does. This phase is characterized by slight weight loss of the whole larva, cessation of the growth of the ring gland, greatly reduced rate of growth of the cuticle and the fat bodies, and cytological changes in the large cells of the ring gland. It seems to be due to hormonal disturbance; detailed analysis of the radiation effects yields some implications on the nature of the normal hormonal control. Several direct radiation effects were also observed in organs rapidly dividing at the time of irradiation. Recovery from the direct effects is not coordinated with the over-all development; this results in morphological distortions. (auth: H. Q.)

1304 Cornwell, P. B., Burson, D. M. GRAIN WEEVILS, CALANDRA GRANARIA L. AND C. ORYZAE L., REARED ON IRRADIATED WHEAT. Nature 181 (1958) 1747-8.

Grain, having received doses up to 5×10^4 rad from Co^{60}, can be used for rearing C. granaria and C. oryzae, without in any way interfering with their development. The yield of progeny, their weight and rate of emergence were unaffected by radiation treatment.

1305 Fritz-Niggli, H. QUANTITATIVE UND QUALITATIVE ANALYSE DER RÖNTGENSCHÄDIGUNG IM DROSOPHILA-VERSUCH (Quantitative and qualitative analysis of roentgen ray injury in Drosophila melanogaster). Fortschr. Röntgenstr. 76, (1952) 218-54. (In German)

The pupa of Drosophila melanogaster represents a good subject for actinobiological and special ontogenetic experiments because tissue is found in histolysis as well as in morphologic and cytological differentiation and at rest. Irradiation of pupas of various ages (5, 15, 22, 30, 40, 50 and 72 h) with 6000, 12 000, 36 000 and 80 000 r (50 kV, 2 mA and 180 kV, 6 mA) showed that the radiosensitivity of the chrysalis diminishes with advancing age. Detailed studies on the changes in body wall, bristle design, hypodermis, muscles, fat cells, gonads, cell differentiation, etc. are reported. 35 figures. (NSA 6: 2665, 1952)

1306 Gaulden, M. E., Totter, J. R. EFFECT OF X-RAYS ON NUCLEIC ACID SYNTHESIS AND ON MITOSIS. p. 1095 in "Proceedings of the 9th International Congress on Genetics, Bellagio, Italy 1953", Suppl. to Caryologia 6. Montalenti, G., Chiarugi, A., eds. Florence. 1954.

Inhibition of mitosis in embryos of the grasshopper Chortophaga viridifasciata at low doses of radiation is not related to an alteration in nucleic acid synthesis. As the 100% lethal dose (approximately 300 r) is approached, interference with nucleic acid synthesis becomes evident.

1307 Glass, B., Plaine, H. L. THE IMMEDIATE DEPENDENCE OF THE ACTION OF A SPECIFIC GENE IN DROSOPHILA MELANOGASTER UPON FERTILIZATION. Proc. nat. Acad. Sci. Washington 36 (1950) 627-34.

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 "erupt" to manifest itself in the adult stage. The fact 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.

1308 Glass, B., Plaine, H. L. THE ROLE OF OXYGEN CONCENTRATION IN DETERMINING THE EFFECTIVENESS OF X-RAYS ON THE ACTION OF A SPECIFIC GENE IN DROSOPHILA MELANOGASTER. Proc. nat. Acad. Sci. Washington 38, 8 (1952) 697-705.

X-ray treatments of embryos of the suppressor-erupt stock block the action of a specific suppressor gene (Su-er) and allow the suppressed mutant gene erupt (er) to manifest itself in the adult stage. This stock also shows a high incidence of melanotic tumors (81.7%) induced by x-rays. When embryos were irradiated with 1000 r units at 10 ± 1 h in concentrations of 0% O_2, 10% O_2, 20% O_2, and pure oxygen, there was, with increasing oxygen concentration, (1) increased inhibition of the action of the suppressor gene, with corresponding increase in the expression of erupt; (2) 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 number of tumors per affected larva. There is no observable effect when embryos are exposed to various O_2 concentrations without being x-rayed. The incidence of erupt and the incidence of tumors both increase significantly and linearly from 0 to 20% O_2, 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 melanomas all parallel the effects of x-rays on the suppression of erupt at given oxygen tensions; but further work will be required to make clear the nature of the relation between the suppressor of erupt and the parallel effects. (auth. summary)

1309 Gowen, J. W., Stadler, J. IRRADIATION EFFECTS ON VIABILITY OF DROSOPHILA MELANOGASTER. (abstr.) Anat. Record 111 (1951) 497.

Physiological effects of various doses of x-irradiation on day-old male and female imagoes were studied after repeated pair matings. Twenty-six different criteria for the physiological effects are discussed. (NSA 6: 1951, 1952)

1310 Gowen, J. W., Stadler, J. VIABILITY OF DROSOPHILA MELANOGASTER EXPOSED TO X-RAY IRRADIATION. Genetics 37, 5 (1952) 586-7.

2180 Drosophila adults were given single or multiple doses of x-rays. Treatment doses range up to 62 500 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 eggs laid. This seeming threshold indicates the female's physiological functions are not seriously altered. Irradiation fluxes of 2500 r or more show a linear decline in eggs laid as dosage increases; at 20 000 r productivity was but 2%, at 62 000 r less than 0.1%. Total days the female laid eggs measures the resistance to complete interference with functioning of reproductive system as distinct from rates of cell division. A threshold of little or no effect appeared between 0 and 2500 r. Days of egg laying were reduced linearly from 84 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 exposures up to 12 500 r. Flies receiving 62 500 r lived about 60% as long as those without any treatment. Observations show that quantitatively the sexes behave in similar manner when exposed to irradiation. (from abstr.)

(Abstract of paper presented at the 1952 meetings of the Genetics Society of America, Ithaca, New York 8-10 Sep. 1952)

1311 Gray, L. H. PRIMARY SITES OF ENERGY DEPOSITION ASSOCIATED WITH RADIOBIOLOGICAL LESIONS. p. 255-70 (disc. p. 270-4) in CIBA Foundation Symposium on "Ionizing Radiations and Cell Metabolism", Wolstenholme, G. E. W., O'Connor, C. M., eds. London, J. & A. Churchill Ltd., 1956.

Metabolic pathways in the development of radiobiological damage are discussed. The question of nuclear transfers is considered in some detail, and the implications of findings reported elsewhere on Drosophila eggs, Habrobracon and silkworm are discussed. Mention is made in the general discussion (p. 272) that no difference in radiation sensitivity between the diploid and the triploid Drosophila has been found.

1312 Grégoire, C. COAGULATION DE L'HÉMOLYMPHE CHEZ LES INSECTES IRRADIÉS PAR LES RAYONS X. Arch. int. Physiol. Biochim. 63, 2 (1955) 246-8.

Les rayons x ont été administrés en une dose unique. Dans l'ensemble, le pourcentage de coagulocytes actifs diminue progressivement, mais temporairement. (BS 17-100055, 1956)

1313 Grosch, D. S. THE RESTORATION OF EGG PRODUCTION AFTER A RADIATION-INDUCED LAPSE IN HABROBRACON. J. Elisha Mitchell Sci. Soc. 72 (1956) 198.

1314 L'Héritier, M. P., Plus, N. INACTIVATION PAR LES RAYONS X DU VIRUS RESPONSABLE DE LA SENSIBILITÉ AU CO_2 CHEZ LA DROSOPHILE. C. R. Acad. Sci., Paris 231 (1950) 192-4.

La marche de l'inactivation du virus par les rayons X est du type courbe à un coup. Le diamètre de la cible est de 42 mμ. (auth.)

1315 Joly, P., Biellmann, G. EFFETS D'IRRADIATIONS CHEZ LOCUSTA MIGRATORIA L. C. R. Acad. Sci., Paris 247, 2 (1958) 243-6.

Cette étude montre qu'une dose de rayons X (4700 r) supportable pour un adulte tue une larve de Locusta migratoria. Si l'irradiation est pratiquée avant une certaine période critique, l'irradiation empêche la mue prochaine bien que l'animal survive au-delà de la date de mue des témoins; passé cette période critique, l'irradiation est sans aucun effet sur la prochaine mue qui se produit dans des délais parfaitement normaux mais empêche la mue suivante. Des recherches antérieures nous ont montré que la date de 60 h après la troisième mue coïncide approximativement avec la période des mitoses et du décollement cuticulaire préparant la quatrième mue. On peut donc songer à une action directe des rayons X sur l'hypoderme entravant les processus d'initiation de la quatrième mue. (conclusions)

1316 Kaplan, W. D., Hochman, B., Holden, J. T. PATTERNS OF FREE AMINO ACIDS IN DROSOPHILA MELANOGASTER. Genetics 42 (1957) 381.

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 D. melanogaster before and after x-irradiation. Strain, male and female, and different life stage patterns have been compared. Amino acids occurring in high concentration are ethanolamine phosphate, glutamic acid, taurine, alanine, β alanine, glutamine, and proline. Lesser quantities of glutathione, the leucines, histidine, arginine, asparagine, lysine, aspartic acid, cystine, valine, tyrosine, serine and glycine have been found. A difference in the amount of a substance tentatively identified by chromatograph techniques as methionine has been found to exist between males and females. The level of this substance is higher in females than in males and is apparently intermediate in XO males. Data on the identification and quantitative determination of this substance will be presented.

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

1317 Karpov, A. E. A COMPARISON OF THE INFLUENCE OF SOFT AND HARD X-RAYS ON THE MANIFESTATION OF POLYHEDRAL DISEASE IN THE SILKWORM. Rep. Acad. Sci. Ukr. No. 11, (1960) 1552-4. (In Ukrainian)

A comparative study was undertaken of the influence of soft and hard x-rays (dosage 5000 r) on the activation of the latent nuclear polyhedral virus in the silkworm (Bombyx mori L., breeds US-I and B-II). The incidence of induced polyhedrosis depends on the kind of irradiation, as well as on the hereditary properties

and stage 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: 10670, 1961)

1318 King, R. C. DOSE RECEIVED BY THERMAL NEUTRON TREATED DROSOPHILA MELANOGASTER. Nucleonics 12, 9 (1954) 58-9.

Data on the chemical composition and neutron 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 radiations activated by protons resulting from nitrogen capture reactions. (NSA 8: 6387, 1954)

1319 King, R. C., Wilson, L. P. STUDIES OF THE RADIATION SYNDROME IN DROSOPHILA MELANOGASTER. Radiation Res. 2 (1955) 544-55.

Effects of single exposures to massive radiation doses on mortality, oxygen consumption, growth, feeding behaviour and certain aspects of phosphorus metabolism are described. Irradiation with approximately 60 000 r kills fasted adult D. melanogaster within 1 d and is lethal to 60% of the nonfasted flies within 2 weeks. Males 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 females have fast and slow phases of P turnover with lengthened half-times. The phase systems of fast and slow half-time are affected to 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 0.9 d for normal females, 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 depressing effect on food intake and a depressing effect 6 d after treatment on the oxygen consumption of the flies.

(See also research report BNL-1978, Brookhaven National Lab., Upton, N. Y., 1954, 24 p)

1320 Mortreuil-Langlois, M. EFFET DES RAYONS X SUR L'INTESTIN MOYEN DE BLABERA FUSCA BR. C. R. Soc. Biol., Paris 154 (1960) 1769-1770.

Nous avons étudié l'apparition des radiolésions de la muqueuse du mésentéron chez Blabera fusca Br. irradiée à la dose de 25 000 r. Les cellules les plus radiosensible sont celles de régénération, au moment de leur différentiation en éléments sécréteurs. L'irradiation ne supprime pas la sécrétion des cellules épithéliales. (auth.)

1321 Passonneau, J. V. THE EFFECT OF X-IRRADIATION ON THE METABOLISM OF PHOSPHORUS-CONTAINING COMPOUNDS IN MELANOPLUS DIFFERENTIALIS EGGS. Physiol. Zool. 27 (1954) 119-28.

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

(A detailed 24 p-report was published in 1952. AECU-2304, Massachussetts Inst. of Technol., Cambridge and UAC-663, Argonne National Lab., Lemont, Ill.)

1322 St. Amand, W., Gaulden, M. E., Totter, J. R. EFFECT OF X-RAYS ON NUCLEIC ACID SYNTHESIS IN EMBRYOS OF THE GRASSHOPPER, CHORTOPHAGA VIRIDIFASCIATA. (abstr.) J. Tenn. Acad. Sci. 29 (1954) 185-6.

1323 Tahmisian, T. N., Adamson, D. M. OXIDASE INCREASE IN MELANOPLUS DIFFERENTIALIS EGGS CAUSED BY X-IRRADIATION. Anat. Record 108 (1950) 516, abstr. 16.

When diapause eggs of Melanoplus differentialis are x-irradiated (200 kV, 15 mA) with dosages ranging between 25 000 r and 200 000 r, the hydroquinone oxidase activity in the eggs is decreased immediately after the exposure. The enzyme activity increases with time so that the highest activity is obtained approximately 8 d after exposure. Oxidase activity after irradiation varies in the following sequence: 25 000 r > 50 000 r > 100 000 r > 200 000 r > control. The oxidase is inhibited by cyanide, carbon monoxide, and heat. Its activity is not affected by azide, phenylthiourea, nor diethyldithiocarbamate. The

oxidase is specific for hydroquinone and, in addition, it appears to have some effect on p-phenylene-diamine. It does not oxidize the -SH group in glutathione nor crysteine. Resorcinol or tyramine hydrochloride is also not oxidized by the enzyme. The nitroprusside test reveals that the native -SH groups are not oxidized as long as 124 h after x-irradiation. However, by 18 d practically all —SH groups are absent. The increase in hydroquinone 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 zymogens in the egg.

1324 Tahmisian, T. N., Adamson, D. M. OXIDASE INCREASE IN MELANOPLUS DIFFERENTIALIS EGGS CAUSED BY X-IRRADIATION. J. exp. Zool. 115, 2 (1950) 379-97.

An abstract of this paper was published in Anat. Record 108 (1950) 516, abstr. 16.

1325 Tahmisian, T. N., Gasvoda, J. THE EFFECT OF β IRRADIATION ON THE RESPIRATION AND MORPHOLOGY OF MELANOPLUS DIFFERENTIALIS EMBRYOS. Trans. Ill. Acad. Sci. 44 (1951) 235-52.

Low dosages of β-radiation 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 Flemming's triple stain it was shown that β-irradiation caused pyknotic chromatin to remain as if it were in the metaphase condition. There is evidence that injury sustained by the chromosomes may be direct and indirect. β-irradiation caused the appearance of some osmophilic material associated with the chromosomes. The nature of this material is as yet unknown. Details of experimental procedure are given. The sources of β-radiation where P^{32} and Sr^{89}. The embryos were treated with carrier-free P^{32} containing 2.33 μc per 0.1 cm^3 calculated to give 3.1 r/h, and exposed to the above source from 2.5 - 24 h. Those used for respiration studies were exposed to P^{32} and Sr^{89} solutions containing from 2.25 μc to 2930 μc for periods from 1 - 6 h. Equivalent amounts of phosphate or strontium chloride were place in the vessels containing the controls.

(An abstract was also published as report UAC-350, Argonne National Lab., Lemont, Ill., Feb. 1951. Also published as AECU-1258, Nebraska Univ., 1951, 40 p)

1326 Tahmisian, T. N., Passonneau, J. V., Adamson, D. M. THE EFFECT OF X-IRRADIATION AND LOWERED METABOLIC RATE ON THE MORPHOGENESIS OF DEVELOPING MELANOPLUS DIFFERENTIALIS EMBRYOS. J. nat. Cancer Inst. 14 (1954) 941-53.

The extent of x-ray injury in developing grasshopper embryos was determined by cytological, morphological, and physiological examination. At an optimum dose of x-radiation the capacity of the cells to maintain organization was abolished, and they underwent regression in 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 300 times that measured anaerobically. The sequence of biological susceptibility to x-irradiation is: tissue differentiation > cell division > anabolism > catabolism. (auth.)

1327 Tahmisian, T. N., Devine, R. L. EFFECT OF METABOLIC POISONS ON IRRADIATION DAMAGE. Fed. Proc. 13 (1954) 150, abstr. 496.

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 25 000 r in air and then in either 1×10^{-3} M KCl, 100% CO, or mixtures of CO and O_2 or 95% N_2 5% CO_2 5 min after irradiation for 24 h. In each case negative growth, which occurs in air 16 d after this irradiation, was arrested 30 to 50%. Statistical analyses indicate that this trend is highly significant. If embryos were irradiated in CO, KCN, or 4 atmospheres of O_2 and then placed in air, the latter 2 resulted in greater regression while CO afforded almost complete protection. The ability of O_2 and KCN to form radicals at the time of irradiation is well known, and suggests that radical formation at the time of exposure is a factor in increased radiation susceptibility. On the other hand, metabolic stasis at the time of irradiation as previously reported with N_2/CO_2 (95% and 5%, respectively) and presently with CO, as well as lowering metabolism following irradiation with KCN, CO and N_2/CO_2 and CO/O_2 mixtures, suggests that the metabolic rate at the time of irradiation, or immediately after irradiation is directly proportional to the degree of damage produced.

1328 Tahmisian, T. N., Devine, R. L. REPRESSION AND ENHANCEMENT OF IRRADIATION EFFECTS ON GRASSHOPPER CELLS BY METABOLIC POISONS AND OXYGEN. Radiation Res. 3, 2 (1955) 182-90.

Diapause embryos of the grasshopper Melanoplus differentialis, when irradiated at 25 000 r in air, undergo negative growth. Conditions were altered by the presence of various metabolic poisons and O_2, either before and during, or after irradiation to study modifications of irradiation effects. The degree of negative growth was less if cyanide was given after irradiation. There was also protection when eggs were irradiated under 4 atmospheres of O_2 and then transferred to N_2CO_2, and particularly so when irradiated in air and then put in N_2CO_2. Protection was evident when eggs were irradiated in CO: O_2 (80%: 20%) in the dark (but not in the light or when added after) and when irradiated in CO in the dark. Ovarian eggs that have high tetrazolium-reducing capacity are more resistant. It is suggested that there may be a relationship between the resistance of tissue to irradiation and its dehydrogenase content. There is a strong indication that radioprotective substances depend on the H and electron transfer of tissues and cells. A statistical analysis of the methods is presented. (auth.)

1329 Tahmisian, T. N., Wright, B. J. IMMEDIATE EFFECT OF X-RAYS ON THE DPN-DPNH RELATIONSHIP IN GRASSHOPPER EGGS. Fed. Proc. 15 (1956) 184, abstr. 598.

Grasshopper eggs in the diapause stage of development were used to determine whether the DPN-DPNH balance in vivo is changed under irradiation. Theoretically, the radicals formed from H_2O and O_2 by radiation have a half life of 1×10^{-8} s to 1×10^{-7} s. Therefore at any dose rate, the rate of disappearance of radicals should equal the rate of formation within 1 μs, and the resulting constant level attained should be dependent on dose rate rather than on accumulated dose. The grasshopper eggs, which are approximately 5 mm^3 in volume, were introduced into boiling water while under the x-ray beam, to fix the DPN-DPNH relationship during the period of irradiation. Controls consisted of eggs treated in the same manner except that they were not irradiated. A 3rd group of eggs was irradiated and then killed, to determine whether partial recovery toward the DPN-DPNH relationship of the controls would occur. In eggs killed while under x-ray beam the ratio of DPN to DPNH content is higher than that of the controls. In eggs killed a few minutes following irradiation, this ratio of DPN to DPNH is higher than that of the controls but lower than that of eggs killed under the beam. This suggests partial reduction following irradiation. On the basis of the above observations we may assume that when biological material is irradiated in the presence of oxygen more oxidative than reducing radicals are formed.

1330 Taira, T., Nawa, S. THE EFFECTS OF X-IRRADIATION ON NITROGEN METABOLISM IN DROSOPHILA MELANOGASTER. Mishima. Nat. Inst. Genet. Annu. Rep. 7 (1956, pub. 1957) 83-4.

1331 Tazima, Y. RADIATION BIOLOGY OF THE SILKWORM. Proc. 6th Mtg Tokai District Seric. Soc. Jap. (1958) 31-5. (In Japanese)

1332 Tazima, Y. RADIATION PHYSIOLOGY OF THE SILKWORM, WITH SPECIAL REFERENCE TO THE EFFECT OF RADIATION ON GERM-CELLS. p. 249-271 in "Recent Advance in Experimental Morphology". Takewaki, Harizuka, Fukaya, eds. Tokyo, Yokendo. 1959. (In Japanese)

1333 Terzian, L. A. THE EFFECT OF X-IRRADIATION ON THE IMMUNITY OF MOSQUITOES TO MALARIAL INFECTION. J. Immunol. 71, 4 (1953) 202-6.

The mosquito Aëdes aegypti, in common with other insects, is extremely resistant to high doses of x-irradiation. Mortality did not reach 100% in groups exposed to 40 000 r and 30 000 r until the 12th and 21st post-irradiation days, respectively, while in groups exposed to 20 000 r mortality was 95% on the 30th day. In groups exposed to 10 000 r and 5000 r mortality was 28% and 18%, respectively, at the end of 30 d. In non-irradiated control colonies mortality was 10% at the end of 30 d, and the average life span of these laboratory mosquitoes was approximately 45 d. X-irradiation doses ranging from 5000 to 30 000 r produces a significant increase in the innate resistance of A. aegypti to infection with the malarial parasite Plasmodium gallinaceum, and this effect is increased with increasing x-irradiation. Penicillin and sulfadiazine, when administered to x-irradiated mosquitoes prior to infection, are capable of reversing the effects on host immunity produced by exposure to x-irradiation and re-establishing what would appear to be a normal host-parasite equilibrium. (auth. summary)

1334 Tipton, S. R., St. Amand, G. S. THE EFFECTS OF X-RAYS ON THE RESPIRATORY METABOLISM OF EGGS AND EMBRYOS OF THE GRASSHOPPER CHORTOPHAGA VIRIDIFASCIATA. Physiol. Zool. 27, 4 (1954) 311-7.

The O_2 consumption of Chortophaga eggs measured at 38°C in O_2 averaged 78.8 ± 3.3 mm^3 O_2/100 eggs/h and increased 28% during a 4-h period of respiratory determination. When measured at 38°C in air, the rate of O_2 consumption did not change during a 4-h 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 40 embryos in Warburg flasks and of individual embryos in Gregg respirometers. X-ray doses of 10 000 r and above significantly reduced the O_2 consumption of 14-d Chortophaga eggs in the first hour after treatment. Doses of 3500 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)

1335 Wharton, M. L., Wharton, D. R. A. THE PRODUCTION OF SEX ATTRACTANT SUBSTANCE AND OF OÖTHECAE BY THE NORMAL AND IRRADIATED AMERICAN COCKROACH, PERIPLANETA AMERICANA L. J. Insect Physiol. 1, 3 (1957) 229-39.

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 as oöthecal production increases. Mating induces an increase in oöthecal production, especially among younger cockroaches. Cathode-ray irradiation (from a 2-MeV Van de Graaff electron accelerator) damages oöthecal and attractant production. With oöthecal 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 ovulation. (auth.)

1336 Whiting, A. R. FAILURE OF PUPATION OF EPHESTIA LARVAE FOLLOWING EXPOSURE TO X-RAYS. Anat. Record 108 (1950) 609.

The Mediterranean flour moth, E. kühniella, belongs to the group of insects (homodynamic) in which a a continuous succession of generations occurs so long as conditions are favourable. In the course of several experiments full-grown larvae were irradiated with doses ranging from 40 000 to 160 000 r. Following a short period of inactivity they moved about normally and were readily stung and fed upon by the parasitic wasp Habrobracon. Those not exposed to the parasite continued to crawl, and none pupated. All lived for at least a few days and some (41/177 or 23.16%) were still alive 30 to 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 (heterodynamic) 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 disks vital to pupal formation is not known. Two irradiated in the prepupal stage pupated but failed to eclose.

(Abstract of paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, 27-30 Dec. 1950.)

1337 Witte, E., Sigmund, R. ULTRAFRACTIONATION. II. ADDITIONAL EXPERIMENTAL STUDIES OF THE BIOLOGICAL EFFECT OF AN INTERMITTENT IRRADIATION. Strahlentherapie 88 (1952) 384-94.

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 s and 4×10^{-5} s. If such an effect exists for eggs it must appear at shorter irradiation times than 4×10^{-5} s. Significance of the ultrafractionation effect for explaining the biological action of betatron radiation is discussed. (NSA 7: 726, 1953)

1338 Yanders, A. F. THE EFFECT OF X-RAYS ON SPERM ACTIVITY IN DROSOPHILA. (abstr.) Genetics 44 (1959) 545-6.

A study was made of the post-copulatory migration of spermatozoa from the vagina to 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 spermatozoa. 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 (1958) has shown that unfertilized eggs may contribute significantly 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 a laying female.

Effects on feeding activity

* Clark and Kelly 1950 - [863]

1339 Henderson, B. J., Baxter, R. C., Tuttle, L. W. THE EFFECT OF A HIGHLY IRRADIATED FOOD MEDIUM ON LIFE SPAN AND DEVELOPMENT OF DROSOPHILA MELANOGASTER. (abstr.) Radiation Res. 7, 3 (1957) 321.

Five successive generations of Drosophila melanogaster were grown on a brewer's yeast medium irradiated with 1 million rep of γ-rays from a Co^{60} source. The irradiation dose selected lies between the pasteurizing dosage 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 in comparison with flies grown on unirradiated medium. If toxic substances are produced in an aqueous yeast suspension by the application of 10^6 rep of γ-radiation, 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 UR-483, Rochester, N. Y. Univ., Atomic Energy Project, 1957, 86 p)

1340 Hodges, R., Guyer, G. THE EFFECTS OF AN IRRADIATED WHEAT DIET ON THE CONFUSED FLOUR BEETLE, GRANARY WEEVIL AND THE ANGOUMOIS GRAIN MOTH. J. econ. Ent. 51, 5 (1958) 674-5.

In experiments to determine whether grain irradiated with cathode rays in a Van de Graaf accelerator (cf. RAE-A 44: 272) differed from untreated grain as a food for Tribolium confusum Duv., Calandra (Sitophilus) granaria L. and Sitotroga cerealella (Ol.), wheat irradiated at 10^4, 10^5 or 10^6 rep had no apparent deleterious effect on the reproduction potential of insects reared on it. When differences did exist, an increase in reproduction was evident. (RAE-A 48 (1): 29, 1960)

1341 Родионова, Л.З. ИЗМЕНЕНИЕ АКТИВНОСТИ ПИТАНИЯ ЖУКОВ АМБАРНОГО ДОЛГОНОСИКА, ОБЛУЧЕННЫХ Х-ЛУЧАМИ. Труды всес. н.-и. ин-та зерна и продуктов его переработки, Москва 35 (1958) 58-61.

Жуков (Ж) облучали из рентгеновской установки РУП-3 (200 кв, фильтр 0,5 мм Cu) дозой 10 000 р при мощности дозы 950 р в 1 мин. В 1-й серии опытов определяли через 10, 20 и 30 суток число зерен, поврежденных облученными и контрольными Ж. Через каждые 5 суток удаляли погибших подопытных Ж и столько же живых удаляли в контроле. Во 2-й серии в те же сроки определяли вес пшеницы, съеденной Ж в опыте и контроле, причем зерно предварительно очищали от экскрементов и наточенной Ж мучки. Через 10 и 20 суток зерно в образцах заменяли новым, чтобы исключить влияние личинок, отродившихся в старом зерне. Взамен погибших подсаживали из запаса Ж того же срока облучения. Среднее число зерен поврежденных облученными Ж, по сравнению с контрольными, постепенно уменьшается и через 30 дней достигает 57,2%. Средний вес пшеницы через 10, 20 и 30 суток, съеденной одним облученным Ж, постепенно увеличивается, а съеденной контрольным Ж почти не изменяется (3,43 - 4,03 мг). Вес пшеницы, съеденной в 1-ю и 2-ю декаду облученными Ж, почти в два раза меньше, чем контрольными Ж. Но к исходу 3-й декады это кол-во выравнивается, так как в первые 20 суток ~90% облученных Ж погибает, а выжившие, наиболее устойчивые Ж питаются так же активно, как и контрольные.

Rodionova, L. Z. CHANGE IN THE FEEDING ACTIVITY OF GRAIN WEEVILS (CALANDRA GRANARIA L.) AFTER X-IRRADIATION. Trudy vses. n.-i. in-ta zerna i produktov ego pererabotki (Trans. All-Un. sci. Res. Inst. Grains and Products of Processed Grain) 35 (1958) 58-61.

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 from the controls. By 30 d, the damage done by irradiated weevils was 57.2% less than by the controls.

The weight of wheat consumed by irradiated weevils at the end of 10 and 20 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 Referativny Zhurnal Biologia 1: 7083 (1959))

1342 Rogers, W. I., Hilchey, J. D. THE EFFECT OF BETA RADIATION ON THE FEEDING ACTIVITY OF TRIBOLIUM SPP. Bull. ent. Soc. Amer. 3, 3 (1957) 25, abstr. 24.

Irradiated Tribolium adults lived longer in a culture medium of wheat flour than in the absence of a medium or in the presence of Celite 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 subsistence items after the beetles have been exposed to doses of beta radiation which produce delayed lethal effects.

1343 Rogers, W. I., Hilchey, J. D. STUDIES ON THE POSTIRRADIATION FEEDING ACTIVITY OF TRIBOLIUM CASTANEUM (TENEBRIONIDAE: COLEOPTERA). Ann. ent. Soc. Amer. 53, 5 (1960) 584-90.

Adults that had been exposed to selected doses of high-speed electrons were subsequently offered various diets. Longevity studies and radioisotopic tracer studies showed that they fed to some degree after irradiation. After exposure to 27400 rads or more, feeding ceased for at least 2 d, then was resumed between the 2nd 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 dosages of radiation affected their life expectancy. At least two dose-dependent modes of mortal response to irradiation with high-energy electrons were exhibited by T. castaneum, and starvation was not a primary cause of death in irradiated individuals. (auth.)

I-C-7 TUMOUR FORMATION

1344 Fahmy, O. G., Fahmy, M. J. CYTOGENETIC ANALYSIS OF THE ACTION OF CARCINOGENS AND TUMOR INHIBITORS IN DROSOPHILA MELANOGASTER. V. DIFFERENTIAL GENETIC RESPONSE TO THE ALKYLATING MUTAGENS AND X-RADIATION. J. Genet. 54 (1956) 146-64.

Work on the alkylating compounds, described here, gives the first decisive evidence for the nonrandomness 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 (or visibles) affected, (b) the ratio of the recessive visibles/lethals 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 "new" sex-linked recessive visibles, resulting in phenotypic expressions 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 visibles. The selectivity here discernible 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 visibles/lethals in the same sample of treated chromosomes is exceptionally high for a particular amino mustard [p, N-bis (chloroethyl) phenyl-alanine], 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(ethylenimino) triazine there is a fixed proportion showing cytologically detectable chromosome aberrations, i.e., major rearrangements and deficiencies. (CA 50: 5903g, 1956)

1345 Ghelelovitch, S. SUR LE DÉTERMINISME DE LA SENSIBILITÉ À L'ACTION TUMORIGÈNE DES RAYONS X CHEZ DROSOPHILA MELANOGASTER MEIG. C.R. Acad. Sci., Paris 260 (1960) 1387-8.

La réponse à l'irradiation par la formation des tumeurs mélaniques dépend, chez la drosophile, de la constitution héréditaire 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 "gène tumoral" responsable de la prédisposition héréditaire à la tumorigénèse spontanée. (auth.)

* Glass and Plaine 1952 - [1185]

1346 Glass, B., Plaine, H. L. A BIOCHEMICAL ANALYSIS OF FACTORS PRODUCING MELANOTIC TUMORS AND ERUPT EYES IN THE SUPPRESSOR-ERUPT STOCK OF DROSOPHILA MELANOGASTER. p. 1163-7 in "Proceedings of the 9th International Congress on Genetics, Bellagio, Italy 1953", Suppl. to Caryologia 6. Montalenti, G., Chiarugi, A., eds. Florence, 1954.

D. melanogaster embryos of the suppressor-erupt stock, treated with x-rays showed a high incidence of melanotic tumours in 3rd instar larvae and manifestation of erupt eyes in adults. These effects depend on the concentration of oxygen in the atmosphere at irradiation. Effects of exposure to O_2 without irradiation and of exposure to H_2O_2 were also tested. The experiments indicated that the effect of the x-rays in producing both melanotic tumours and erupt eyes might result from the production by oxygen of H_2O_2 or potent oxidizing agents with an action analogous to that of peroxide. The effects of intermediates in tryptophan metabolism on the incidence of tumours and erupt eyes were also studied.

1347 King, R. C. OÖGENESIS IN ADULT DROSOPHILA MELANOGASTER. III. RADIATION-INDUCED OVARIAN TUMORS. Growth 21 (1957) 129-35.

Ovarian tumours are induced in D. melanogaster by ionizing radiation. A dose of 4000 r of Co^{60} γ-rays produces an incidence of tumours 26 times the control rate. A mechanism of tumour formation is postulated.

1348 Plaine, H. L., Glass, B. THE EFFECT OF OXYGEN CONCENTRATION UPON THE INDUCTION BY X-RAYS OF MELANOTIC TUMOURS IN DROSOPHILA MELANOGASTER. Cancer Res. 12 (1952) 829-33.

A stock of Drosophila melanogaster contained a suppressor gene (I) inhibiting the manifestation of erupt (a mutant that produces an abnormal growth of tissue which erupts through the eye). When the embryos were x-rayed, I was blocked and melanotic tumours arose. On increasing oxygen concentrations from 0 to 20% at the time of irradiation, the incidences of tumours and erupt increased linearly; on further increase of oxygen concentration to 100% there was a small further increase in tumours 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 tumours in both stocks was slightly increased by exposure of the embryos for 10 min to pure oxygen without x-rays, and was decreased by similar exposure to pure nitrogen. I was not affected by oxygen in the absence of x-rays. (CA 47: 5537i, 1953)

(An abstract of a similar paper, "The role of oxygen concentration in determining the effectiveness of x-rays on the action of a specific gene and on tumour formation in Drosophila melanogaster" by the same authors appeared in Genetics 37 (5) (1952) 614).

1349 Plaine, H. L. EFFECT OF OXYGEN AND HYDROGEN PEROXIDE ON THE ACTION OF A SPECIFIC GENE AND ON TUMOR INDUCTION IN DROSOPHILA MELANOGASTER. Genetics 40 (1955) 268-80.

The results obtained when embryos are exposed to solutions of hydrogen peroxide or to 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 auth. summary)

* Plaine 1955 - [1405]

1350 Tahmisian, T. N., Wright, B. J. TERATOGENESIS IN GRASSHOPPER (MELANOPLUS DIFFERENTIALIS) EMBRYOS AS A FUNCTION OF THE DOSE RATE OF X-IRRADIATION. (abstr.) Anat. Record 128, 3 (1957) 632.

Seven day prediapause grasshopper embryos Melanoplus differentialis differentialis Thomas were irradiated with 250 r of x-irradiation (200 kV, 15 mA) at dose rates of 1 r per min and 200 r per min. The embryos were dissected out of the eggs and observed at 21 d prediapause or 14 d postirradiation. Those embryos that received 200 r per min had terata at a ratio of 8 to 5 in comparison to those that received the same total dose at 1 r per min. Other embryos receiving 200 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 250 min interval of irradiation at 1 r per min. Splitting the dose did not make any significant differences upon the incidence of teratogenesis in comparison to those that received 250 r in 1¼ min. This is indicative that there is an intrinsic mechanism for recovery from irradiation.

1351 Taira, T., Morita, T. MELANOTIC TUMORS INDUCED IN DROSOPHILA MELANOGASTER BY IONIZING IRRADIATION. Mishima. Nat. Inst. Genet. Annu. Rep. 8 (1957, pub. 1958) 82-4.

I - D Combination or Comparison of Several Treatments (Other Radiations, Heat, Chemicals, etc.)

Surveys

1352 Gray, L. H. CONDITIONS WHICH AFFECT THE BIOLOGIC DAMAGE RESULTING FROM EXPOSURE TO IONIZING RADIATION. Acta radiol., Stockh. 41 (1954) 63-83.

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 O_2 tension on damage induced by Röntgen radiation follows a strikingly similar pattern in the case of 5 different biologic responses in plant and insect cells, whereas its influence on α-ray and neutron damage is relatively slight.

1353 Laser, H. THE INFLUENCE OF OXYGEN ON RADIATION EFFECTS. p. 106-16 (disc. p. 116-9) in CIBA Foundation Symposium on "Ionizing Radiations and Cell Metabolism". Wolstenholme, G. E. W., O'Connor, C. M., eds. London, J. and A. Churchill Ltd. 1956.

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 O_2. The approach of the physicochemist to the problem of the O_2 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.

1354 Abrahamson, S. CONCERNING THE EFFECTS OF DIFFERENT OXYGEN TENSIONS ON THE REARRANGEMENT PROCESSES WITH FRACTIONATED X-RAY TREATMENTS OF DROSOPHILA OÖCYTES. Diss. Abstr. 17, 2 (1957) 441-2.

1355 Abrahamson, S. THE INFLUENCE OF OXYGEN ON THE X-RAY INDUCTION OF STRUCTURAL CHANGES IN DROSOPHILA OÖCYTES. Genetics 44 (1959) 173-85.

Through the use of x-ray dosage fractionation methods, it became possible for the first time to demonstrate in Drosophila oöcytes effects of oxygen concentration on induced gross chromosomal rearrangements and to test separately the effect of different oxygen concentrations applied before, during, or after irradiation. O_2, present at the time of irradiation, results in a significantly greater frequency of half-translocations than produced in air. Anoxia (N_2) 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. Anoxia between the two x-ray fractions increases half-translocation frequency. Although a part of this effect may be by the prohibition of joining of broken ends it seems to be greater than can be expected simply on the basis of this passive role. Post-oxygen treatment had no detected 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 either during or between fractionated x-ray treatment of Drosophila oöcytes" appeared in Genetics 41: 631, 1956)

* Alexander and Stone 1955 - [1156]

1356 Alexander, M. L. THE RELATIONSHIP OF RADIATIONS AND ENVIRONMENTAL CHANGES IN OXYGEN CONCENTRATIONS FOR BIOLOGICAL DAMAGE IN THE IMMATURE GERM CELLS OF DROSOPHILA VIRILIS. p. 3-4 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press, 1958.

Radiation treatment of post-meiotic cells of spermatogenesis in D. virilis resulted in differences in the number of translocations and dominant lethals. Qualitative as well as quantitative differences in radiobiological damage were found in meiotic and spermatogonial cells. Post-meiotic 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 O_2 was present during treatment. O_2 concentrations over 20% (air)

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 meiotic and spermatogonial cells was influenced by increase in O_2 concentrations with x-ray and fast neutrons. Differences in the lethal damage induced in spermatids by γ-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 γ-rays were used in an atmosphere of N_2. (CA 52: 20708a, 1958)

1357 Baker, V. H. SOME EFFECTS OF ELECTROMAGNETIC ENERGY AND SUBATOMIC PARTICLES ON CERTAIN INSECTS WHICH INFEST WHEAT, FLOUR AND BEANS. Ph. D. Dissertation. Michigan State College, Dept. of Agricultural Engineering, 1953.

The effects of infra-red and ultraviolet light, and of x-rays and accelerated electrons are described on Tribolium confusum, Duv., Sitophilus granarius (L.), and Acanthoscelides obtectus (Say). The physical aspects of the work are discussed. (See also Taboada 1953: M. S. Thesis)

1358 Baker, W. K., Sgourakis, E. ALTERATION OF THE X-RAY SENSITIVITY OF DROSOPHILA BY MEANS OF RESPIRATORY INHIBITORS. Genetics 35 (1950) 96.

Males of the Oregon-R strain of D. melanogaster were subjected to x-radiation (1000, 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 2°C. The number of X-chromosomes which bear recessive lethal mutations was determined by mating the treated males to the females of Muller-5 stock 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 O_2 at the warm temperature. This "temperature effect" is not evident when the flies are irradiated in N_2 thus 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 the two temperatures without irradiation. These experiments show no alteration of the spontaneous mutation rate.

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

1359 Baker, W. K., Sgourakis, E. THE EFFECT OF OXYGEN CONCENTRATION ON THE RATE OF X-RAY INDUCED MUTATIONS IN DROSOPHILA. Proc. nat. Acad. Sci., Washington 36 (1950) 176-84.

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 2°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 caused by 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-575, Oak Ridge National Lab., Tenn. 1950, 18 p)

1360 Baker, W. K., Edington, C. W. THE INDUCTION OF TRANSLOCATIONS AND RECESSIVE LETHALS IN DROSOPHILA UNDER VARIOUS OXYGEN CONCENTRATIONS. Genetics 37 (1952) 665-77.

Translocations were induced in Drosophila virilis sperm by exposing to 2000 r of x-rays adult males maintained in various concentrations of oxygen during treatment. Less than ¼ 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 ½ 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 11% 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.)

1361 Baker, W. K., Halle, E. S. von. THE EFFECT OF OXYGEN CONCENTRATION ON THE INDUCTION OF DOMINANT LETHALS. Genetics 37 (1952) 565.

The production of dominant lethals in males of D. melanogaster was studied as a function of x-ray dosage and oxygen concentration (air, 5% O_2 and N_2). 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 N_2 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 O_2 action is less in the case of dominant lethals than that reported for recessive lethals and chromosome aberrations. The further decrease in O_2 effect in the second sperm batch is due solely to a reduction in number of dominant lethals recovered in males treated in air and 5% O_2. The number induced in N_2-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 breaks induced by x-rays is independent of O_2 concentration but that the broken ends formed in N_2 are more likely to rejoin (either to restitute or to form new arrangements) than those induced in air.

(Abstract of paper presented at the 1952 meetings of the Genetics Society of America)

1362 Baker, W. K., Halle, E. S. von. THE BASIS OF THE OXYGEN EFFECT ON X-IRRADIATED DROSOPHILA SPERM. Proc. nat. Acad. Sci., Washington 39 (1953) 152-61.

A study of the relation between x-ray dosage and O_2 concentration on the induction of dominant lethals in mature sperm of D. melanogaster shows that the frequency of dominant lethals induced upon irradiation in N_2 is reduced much less than would be expected on the hypothesis that O_2 concentration is affecting the number of primary breaks induced. Fewer dominant lethals are recovered in sperm exposed in air when at least 24 h have elapsed between treatment and insemination than when insemination very shortly follows treatment. This effect is not observed in N_2-treated sperm. These data can be interpreted on the basis that the O_2 concentration affects the amount of restitution of chromosome breaks taking place in the sperm. A low O_2 concentration during irradiation makes restitution more likely, and the broken ends apparently restitute more quickly. Therefore, the data lend support to the differential reunion hypothesis of O_2 action rather than to the differential breakage hypothesis. (auth.)

1363 Baker, W. K., Halle, E. S. von. EVIDENCE ON THE MECHANISM OF THE OXYGEN EFFECT BY USE OF A RING CHROMOSOME. J. cell. comp. Physiol. 45, Suppl. 2 (1955) 299-308.

Drosophila melanogaster males having the X^{Cl} chromosome and a marked Y were irradiated with x-rays while in an environment of either air or N_2. Induced loss of the ring chromosome was measured by determining the sex ratio in the offspring. At low dosages, only a very small O_2 effect was observed on either the sex ratio or the frequency of X-O males. The data favour the hypothesis that O_2 acts on the rejoining of broken chromosome ends rather than on the initial number of breaks induced by the radiation. (BA 33: 24324, 1959)

1364 Baker, W. K. THE OXYGEN EFFECT AND THE MUTATION PROCESS. p. 191-200 in "Brookhaven Symposia in Biology, 15-17 June 1955", Vol. 8, Brookhaven National Lab., Upton, N. Y. 1957.

The effect of low O_2 concentrations on the mutagenic activity of x-radiation is discussed. 24 references.

* Baldwin 1956 - [1244]

1365 Baldwin, W. F., Narraway, C. A. INTERACTION OF HEAT AND X-RAYS IN KILLING A CHALCID. Nature 179 (1957) 972-3.

Results of experiments carried out on Dahlbominus fuscipennis (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 200 000 r of x-rays. A table also gives the effect of the sequence of exposures 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.

1366 Baldwin, W. F., Narraway, C. A. THE INTERACTION OF HEAT AND X-RAYS ON KILLING IN DAHLBOMINUS FUSCIPENNIS (ZETT.). (abstr.) p. 291 in "Proceedings of the 10th International Congress on Entomology, Montreal, 17-25 Aug. 1956", Vol. 2. Becker, E. C., ed. Ottawa, Mortimer Ltd., 1958.

In previous studies, a marked similarity was found between killing by high temperatures and killing by very high doses of x-rays in adults of Dahlbominus (Baldwin, 1956). In the present experiments, the lethal effects of x-rays were drastically modified by temperatures which are normally non-lethal (10° to 36°C), the effect being observed when the temperatures were applied during or after the irradiation, but not when they were applied before the x-ray (e. g., an increase from 5% up to 100% kill). 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 exposures, significant recovery occurred during the intervening period; doses 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.

1367 Baldwin, W. F. RECOVERY FROM X-RAY-INDUCED SENSITIVITY TO HEAT IN AN INSECT. Radiation Res. 8 (1958) 17-21.

An investigation is described into the recovery of the hymenopterous parasite, Dahlbominus fuscipennis (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 were in excess of 200 for each point on the graphs given. A nonlethal dose of 80 000 r produces a linear sensitivity to heat shock. Thus, if the irradiation is followed immediately by exposure to 43°C for 60 min, which is nonlethal 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 rapid at 32°C as at 12°C. Carbon monoxide inhibits the recovery while present, but recovery resumes when it is removed. Food and pure O_2 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.

1368 Baldwin, W. F., Salthouse, T. N. OXYGEN DEFICIENCY AND RADIATION DAMAGE IN THE INSECT RHODNIUS. Nature 183 (1959) 974.

Unfed 4th instar Rhodnius prolixus nymphs were held in either N_2 or air and irradiated, then fed, and returned to a normal incubator. The delay in molting in N_2 was barely perceptible but was quite large for an equal dose in air. Burns did not develop in N_2 for doses below 120 kr, but were invariably present for 60 kr in air. (NSA 13: 11580, 1959)

1369 Baldwin, W. F., Salthouse, T. N. EFFECT OF OXYGEN DEFICIENCY ON RADIATION-INDUCED MITOTIC DAMAGE IN SYNCHRONOUSLY DIVIDING CELLS. Canad. J. Res., D-Canad. J. Zool. 37, 6 (1959) 1061-6.

The latent effects of x-irradiation in delaying mitosis are readily observable in the epidermis of the insect Rhodnius 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 N_2, a prolonged division was completed with the greater part of the inhibition occurring during metaphase. (auth.)

1370 Bender, M. A. THE COMPARATIVE EFFECTS OF HARD AND SOFT IONIZING RADIATIONS ON MALE AND FEMALE RING X DROSOPHILA IN AIR AND NITROGEN. Genetics 43, 1 (1958) 122-38.

It was shown that breakage, measured as ring loss, is less frequent in x-rayed oöcytes than in x-rayed sperm. This finding and that of Glass (1955) that x-ray-induced Minute mutations in oöcytes are as frequent as those induced in males, are explained by means of an hypothesis. A further study is described of the rates of ring loss in males and in females, in both air and nitrogen, induced by soft x-rays and by hard γ-rays. With x-rays, there was a small but quite significant effect of O_2 on ring loss in X^{Cl}, Y males, and a larger O_2 effect on ring loss in X^{Cl}, Y females. With γ-rays, however, no demonstrable effect of O_2 on the frequency of ring loss in either sex was found. (from auth. summary)

Bertram, C., Höhne, G., Schubert, G. DER EINFLUSS VON RÖNTGENSTRAHLEN UND ZYTOSTATIKA AUF DIE MUTATIONSRATE VON DROSOPHILA (The effects of x-rays and cytostatics on the rate of mutation in Drosophila). Strahlentherapie 112 (1960) 70-3. (In German)

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

* Borstel 1955 - [1177]

1372 Brandt, H. v., Höhne, G. MUTATIONSAUSLÖSUNG BEI DROSOPHILA DURCH SCHNELLE BETATRON ELEKTRONEN UND CHEMISCHE AGENZIEN (Production of mutations in Drosophila by fast betatron electrons and chemical agents). Zool. Anz., Suppl. 16 - Verh. dtsch. zool. Ges. 1951 (1952) 259-63. (In German)

3 MeV electrons were used in experiments on 3-6 d-old males of an inbred D. melanogaster wild strain. The rate of mutations induced depends on dosage. The results for recessive sex-linked lethals (%) induced in mature and immature sperm is tabulated for 3000 r of x-rays and fast electrons (listed for mature sperm 1-3 d and for immature sperm 21-27 d post-irradiation). The mutation rate in immature sperm was found to be 3-4 times higher than in immature gametes. In the immature gametes, the x-ray and electron-induced mutation rates are similar. The following substances were tested for induced mutation rates: ethyl urethane, trichlortriethylamine, 2-methyl-1,4-naphthohydrochinone, a clinically used vitamin K derivative, and p-dimethylaminoazobenzol.

1373 Clark, A. M., Herr, E. B., Conway, J. V. OXYGEN POISONING AND THE EFFECTS OF X-RADIATION ON HABROBRACON PUPAE IN THE PRESENCE OF OXYGEN AND NITROGEN. Genetics 38 (1953) 659-60.

Habrobracon, when exposed to O_2 during the early pupal stages of development, are deleteriously affected. A high proportion of pupae do not complete development and many of the adults that emerge exhibit wing and antennal abnormalities. The diploid female pupae are more sensitive to O_2 than are comparable haploid males. Habrobracon treated at larval and late pupal stages of development are not deleteriously affected. Haploid male and diploid female pupae were x-rayed in the presence of air, O_2 or N_2. The deleterious effects of x-radiation were compared using adult eclosion as the criterion of viability. Comparison of the 50% eclosion value 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 O_2. The increase in radioresistance with N_2 is proportional for the more radiosensitive haploid males and the less radiosensitive diploid females. Haploid males during the pupal stage are more sensitive to x-rays, but less sensitive to O_2 poisoning than comparable females.

(Abstract of paper presented at the 1953 meetings of the Genetics Society of America, Boston, Mass. 28-30 Dec. 1953)

1374 Clark, A. M., Beiser, W. C., Jr. USE OF HAPLOID AND DIPLOID EMBRYOS OF HABROBRACON 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 Habrobracon as the criteria. Data are tabulated on the response of both haploid and diploid embryos to x-radiation, methyl bis(β-chloroethyl)amine HCl, ethyl bis(β-chloroethyl)amine HCl, 2,2'-dichloro-diethylamine HCl, 2,2',2''-trichloro-triethylamine HCl, sodium azide, and potassium cyanide. (NSA 9: 5577, 1955)

1375 Clark, A. M., Herr, E. B., Jr. THE EFFECT OF CERTAIN GASES ON THE RADIOSENSITIVITY OF HABROBRACON DURING DEVELOPMENT. Radiation Res. 2 (1955) 538-43.

Habrobracon during postembryonic development were exposed to x-rays in the presence of air, N_2, CO_2, and H_2. The effects on development to adulthood were observed. Organisms irradiated in nitrogen were about three times as resistant as those irradiated in air at the three stages of development tested. Habrobracon during the larva-in-cocoon stage were more radioresistant when irradiated in the presence of H_2 than in the presence of air. Further, groups irradiated in N_2 or in CO_2 were more resistant to radiation damage than those treated in H_2. Thus, the radiosensitivity was modified by the presence of H_2. The authors conclude

that the data so far indicate no clear relation between O_2 poisoning and x-radiation damage in Habrobracon. (from auth. summary)

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

* Clark 1956 - [943]

1376 Clark, A. M., Cristofalo, V. J. SOME EFFECTS OF OXYGEN ON THE INSECTS, ANAGASTA KUEHNIELLA AND TENEBRIO MOLITOR. TID-6052, Delaware, Univ., Newark and Oak Ridge National Lab., Tenn., 1959, 20 p.

The effects of O_2 at increased partial pressures upon the development and O_2 consumption of larvae and pupae of Anagasta kuehniella and Tenebrio molitor were studied. Anagasta pupae exposed to 15 psi or more of O_2 are prevented from emerging as adults. For 15 psi of O_2, development of the pupae to the adult stage continues but most of these remain entrapped within the pupal skin. Pupae exposed to 30 psi or more of O_2 may become paralyzed and show a marked and irreversible decrease in O_2 consumption. Most of the Tenebrio pupae exposed to 120 psi of O_2 show a marked and irreversible decrease in oxygen consumption and an inability to become pigmented. Paralysis and inability to pigment are correlated with, and probably a consequence of, decreased O_2 consumption. Most of the Tenebrio pupae exposed to 60 psi of O_2 become pigmented but do not develop to the adult stage and emerge. Both larvae and pupae are injured by O_2 and by x-rays. Larvae, however, are more oxygen resistant and radiation sensitive than pupae. The O_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 O_2 and by x-rays. (auth.) (NSA 14: 15500, 1960)

1377 Edington, C. W. THE EFFECT OF S, 2-AMINOETHYLISOTHIURONIUM BROMIDE HYDROBROMIDE (AET) ON THE INDUCTION OF DOMINANT AND SEX-LINKED RECESSIVE LETHALS IN DROSOPHILA MELANOGASTER. Amer. Nat. 92, 867 (1958) 371-4.

A comparison of the effects of injections of S, 2-aminoethylisothiuronium Br. HBr(AET) and saline (as a control) prior to x-ray exposure (4000 r) indicates that AET (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 AET alone did not behave as a mutagen. The difference in behaviour of AET on radiation induced physiological death in mammals and genetic lethality in Drosophila may reside 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 - [1250]

1378 Fahmy, O. G., Fahmy, M. J. CHEMICAL AND RADIATION MUTAGENESIS IN DROSOPHILA MELANOGASTER. p. 205-8 (disc. p. 208-10) in "Progress in Radiobiology. Proceedings of the 4th International Conference on Radiobiology, Cambridge 14-17 Aug. 1955". Mitchell, J. S., Holmes, B. E., Smith, C. L., eds. London, Oliver and Boyd. 1956.

The mutagens used were all alkylating compounds: mustards, epoxides, imines and mesyloxyalkanes. 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 genetics and cytological 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 are also discussed. The alkylating compounds are most effective in the induction of small deficiencies, involving less than 1% of the length of the salivary-gland X-chromosome. They induce 2-3 times as many small deficiencies as mutagenically equivalent doses of x-rays. A tentative interpretation is proposed.

* Fahmy and Fahmy 1956 - [1344]

1379 Fahmy, O. G., Fahmy, M. J. COMPARISON OF CHEMICALLY- AND X-RAY-INDUCED MUTATIONS IN DROSOPHILA MELANOGASTER. p. 437-47 (disc. p. 447-8) in "Advances in Radiobiology. Proceedings of the 5th International Conference on Radiobiology, Stockholm 15-19 Aug. 1956". de Hevesy, G. C., Forssberg, A. G., Abbatt, J. D., eds. London, Oliver and Boyd. 1957.

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 r/min of 250 kV x-rays was used in the radiation part of the work. The mutagens tested were alkylating agents.

1380 Fahmy, O. G., Fahmy, M. J. RESPONSE OF SPECIFIC GENES IN DROSOPHILA MELANOGASTER, TO X-RADIATION AS COMPARED TO THE PHENYLALANINE-MUSTARD. Radiation Res. 9 (1958) 112.

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-di(2-chloroethyl) aminophenyl-alanine. The technique used is that of scoring for certain sex-linked recessive "visibles" in the F_1 progeny of treated males. Females homozygous for the visible loci under test were mated to males who had been irradiated or injected with the chemical mutagen, and the F_1 daughters were scored for the marker genes. For both radiation and chemical experiments the following conditions were standardized: germ cells mutated (sperm and spermatids), chromosome sample scored (50 000 per locus), and mutagenic dose given (inducing about 6% sex-linked recessive lethals). Some of the gene loci tested were the "classic" visibles which are often encountered in radiation experiments and which also occurred spontaneously; but others were "new", ones that occurred frequently in our experiments with various alkylating compounds. The majority of the chemically induced visibles proved to be refractory to x-rays at the dose and size of sample utilized. Under the effect of the mustard, however, these genes did mutate and with an incidence in reasonable agreement with the Poisson expectations. This adds excellent support to the principle of differential gene response to various mutagens.

1381 Fahmy, O. G., Fahmy, M. J. DIFFERENTIAL GENE RESPONSE TO MUTAGENS IN DROSOPHILA MELANOGASTER. Genetics 44 (1959) 1149-70.

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 agents but a variable spectrum of sensitivity was obtained when different chemical mutagens were employed.

1382 Falk, R. DELAY IN JOINING OF X-RAY INDUCED BREAKS BY ANOXIA IN DROSOPHILA MELANOGASTER. Genetics 44 (1959) 509. (abstr.)

A significant increase in the frequency of autosomal translocations could be demonstrated when anoxia was given for 7 h 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.

1383 Fritz-Niggli, H. ULTRASCHALLSCHÄDIGUNGEN UND RÖNTGENEFFEKTE IN DROSOPHILA MELANOGASTER (Damage by ultrasonics and x-ray effects in D. melanogaster). Strahlentherapie 85, 2 (1951) 233-52. (In German)

The effects of ultrasonic irradiation (applied intensities: 0.3, 0.71 and 1.75 W/cm²) and of x-irradiation (180 kV, 6 mA, 1 mm Al, 21 cm target distance, 262 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 are 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 (or nucleus) as well as outside of the cell, the target theory cannot be applied to the observed biological effects in Drosophila. (BA 27: 15431, 1953)

1384 Fritz-Niggli, H. BIOLOGISCHE VERSUCHE MIT DEM 31-MeV-BETATRON (Biological experiments using the 31-MeV betatron). Fortschr. Röntgenstr. 80 (1954) 28-38. (In German)

A preliminary study was made of differences observed following irradiation by 180 keV and 31 MeV, respectively. The ultra-hard radiation was less effective throughout. No reasons can yet be put forward to account for the differences observed in different species. The desirability of testing objects of uniform size, such as Drosophila eggs, was emphasized. A comparison is made for both radiations of data for the LD_{50} for Drosophila eggs aged 1¾ and 4 h, the dose required to cause a 50% spread-wing effect in 5-h-old pupae, and for the frequency of occurrence of lethal factors after irradiation with 3000 r of either radiation.

* Fritz-Niggli 1958 - [825]

* Fritz-Niggli 1959 - [1187]

1385 Gaulden, M. E., Nix, M. EFFECTS OF OXYGEN TENSION ON X-RAY INDUCED MITOTIC INHIBITION. Genetics 35 (1950) 665.

The large neuroblast cells of the embryo of the grasshopper Chortophaga viridifasciata were given 64 r of x-rays while exposed to different tensions of O_2, namely, 100%, 21% (air), 2%, and 0% (N_2, CO_2, or vacuum). The embryos were made into culture preparations. The number of cells completing mitosis in a given period of time was determined, since 22 min is the average duration of mid-mitosis (at 38°C) and since the treatments 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 O_2 tensions. In other words, the duration of the period of complete mitotic inhibition (period after irradiation during which there are no cells in the mid-mitosis stages) is shorter when cells are irradiated in 0 or 2% O_2 than when they are irradiated in 21 or 100% O_2. Experiments are now in progress to determine the sensitivity of cells to radiation in 5 and 10% O_2.

(Abstract of a paper presented at the 1950 meeting of the Genetics Society of America, Columbus, Ohio 11-14 Sep. 1950)

(An abstract of this paper also appeared in J. Tenn. Acad. Sci. 25 (1950) 222)

1386 Gaulden, M. E., Nix, M., Moshman, J. EFFECTS OF OXYGEN CONCENTRATION ON X-RAY-INDUCED MITOTIC INHIBITION IN LIVING CHORTOPHAGA NEUROBLASTS. J. cell. comp. Physiol. 41 (1953) 451-70.

An investigation is reported on the effects of O_2 concentration on radiation-induced mitotic inhibition in grasshopper neuroblasts. The grasshopper embryos were exposed to 3.5, 8 or 64 r of x-rays in N_2, CO_2, vaccuum, and 2, 5, 10, 21 and 100% O_2, and mid-mitotic counts of the living neuroblasts made at 22-min intervals during 6 h. Neuroblast mitosis in vivo was not affected by O_2 tension in the absence of radiation under the experimental conditions used. The depth of depression of mitosis was affected very little, if any, by the presence of O_2 during irradiation. At O_2 concentrations between 0 and 10% the duration of minimum mitotic activity and the interval between x-raying and maximum mitotic activity were correlated with O_2 concentration. The number of cells undergoing mitosis within 6 h of treatment was negatively correlated with O_2 concentration. The effects of 21 and 100% O_2 were not significantly different from those at 10%. It is concluded that the influence of O_2 tension on the response of these cells to radiation involves more than merely a change in the amount of injury produced by the radiation.

* Glass and Plaine 1952 - [1308]

1387 Grodner, R. THE EFFECT OF OXYGEN AND NITROGEN ON X-RAY-INDUCED TRANSLOCATIONS IN DROSOPHILA VIRILIS. M. A. Thesis, Univ. Tenn. 1950.

* Grosch and Sullivan 1954 - [1117]

1388 Haas, F. L., Dudgeon, E., Clayton, F. E., Stone, W. S. FREQUENCY OF CHROMOSOMAL REARRANGEMENTS AS RELATED TO RATE OF IRRADIATION, TEMPERATURE AND GASES. Genetics 37 (1952) 589-90.

The frequency of translocations induced in the sperm of adult Drosophila virilis males, irradiated at a rate of 2000 r/min, was used to measure radiation damage. Comparisons were made of the rates of translocations when x-radiation was applied at 0 - 3°C and at 24 - 26°C, using air, 95% N_2 + 5% O_2, CO + CO_2 + O_2, CO + O_2, or CO_2 + O_2 as the gases in several experiments. Other reports have indicated that a reduction in the amount of O_2 present during irradiation (at relatively slower rates of irradiation) reduces the radiation damage. Although this seems true at room temperatures, it does not occur at 0 - 3°C where reduction in O_2 has not lowered the translocation rate to a marked degree. There is a greater difference between the frequencies of translocations irradiated in air at the low and high temperatures than there is between the frequencies of translocations irradiated at low temperature in air and in 5% O_2. In some mixtures including CO, the frequency of translocations was reduced rather than increased, contrary to the situation reported in Tradescantia. It is obvious that the temperature and rate of irradiation are very important factors in determining the relations between the gases present and the amount of radiation damage.

(Abstract of paper presented at the 1952 meetings of the Genetics Society of America)

* Haas et al. 1954 - [946]

1389 Höhne, G., Künkel, H. A., Struckmann, R. DIE STRAHLENINDUZIERTE MUTATIONSRATE BEI DROSOPHILA NACH CYSTEINAPPLIKATION (The radiation-induced mutation rate in Drosophila, following the use of cysteine). Naturwissenschaften 42 (1955) 491-2. (In German)

The rates of lethal mutations in Drosophila after x-ray, cysteine and combined cysteine plus x-ray treatment are given in tabulated form. In view of the possibility that cysteine might become rapidly oxidized in the tissue fluid of the fly and not reach the germ cells to a sufficient extent, the apparent ineffectiveness of cysteine with regard to mutation should be accepted with reservations.

1390 Hollaender, A., Baker, W. K., Anderson, E. H. EFFECT OF OXYGEN TENSION AND CERTAIN CHEMICALS ON THE X-RAY SENSITIVITY OF MUTATION PRODUCTION AND SURVIVAL. p. 315-26 in "Cold Spring Harbor Symposia on Quantitative Biology", Vol. 16. N. Y., The Biological Lab. 1952, 521 p.

Review paper. Work done on Drosophila forms only a small part of the whole. Lethal effects, chromosome changes and mutations produced are reviewed, also studies of the effects of chemicals, and the mechanisms which may be involved in the action of these chemicals with regard to x-ray sensitivity. Compounds found to afford protection against radiation damage are discussed.

1391 Kaplan, W. D., Lyon, M. F. FAILURE OF MERCAPTOETHYLAMINE TO PROTECT AGAINST THE MUTAGENIC EFFECTS OF RADIATION. I. EXPERIMENTS WITH DROSOPHILA. Science 118 (1953) 776-7.

Bacq and Hervé (Bull. acad. roy. med. Belg. 17 (1952) 13) reported that β-mercaptoethylamine protects mice against the lethal effects of radiation. It does not, however, protect against the mutagenic effects of radiation. Day-old adult wild-type Drosophila males serve as test objects. Groups A and C received 0.25 γ of β-mercaptoethylamine while group B received 0.75% NaCl. Groups A and B received 2400 r of x-radiation 15 min after injection. Dominant lethality was measured by mating irradiated males to virgin Muller-5 females, collecting the eggs, and determining hatchability. There was a sharp decrease in hatchability as a result of irradiation, but no difference was observed between the saline-injected groups (B) and the amine-injected one (A). Sex-linked recessive lethals were determined and no difference was detected between group A and B. The amine did not protect against the lethal somatic effects of 82 000 r delivered during 41 min.

1392 Kenworthy, W. THE EFFECT OF OXYGEN CONCENTRATION ON THE INDUCTION OF LETHALITY AND CHROMOSOMAL ABERRATIONS BY X-RAYS IN HABROBRACON AND SCIARA. Dissertation (Publ. 4939). Pennsylvania Univ., Philadelphia, 1953, 59 p.

(See Diss. Abstr. 13 (1953) 157-8)

1393 Kenworthy, W. EFFECT OF OXYGEN CONCENTRATION ON THE SURVIVAL RATE OF IRRADIATED HABROBRACON EGGS. (abstr.) Genetics 39 (1954) 975-6.

Survival ratios were determined for 3998 Habrobracon eggs x-rayed during meiotic metaphase I in oxygen, air, or nitrogen. Survival of eggs irradiated in nitrogen ranged from 64.6% at 506 r to 10.6% at 2200 r. Survival of eggs irradiated in air ranged from 36.3% at 506 r to no survivors at 2200 r (1.9% survived at 1518 r). Survival of eggs irradiated in oxygen ranged from 27.5% at 506 r to no survivors at doses of 1518 r and above (2.6% survived at 1100 r). Survival ratios were determined for 1622 Habrobracon eggs irradiated during meiotic prophase in oxygen or nitrogen. Survival of eggs irradiated in nitrogen ranged from 92.7% at 1700 r to 20.0% at 24 000 r. Survival of eggs irradiated in oxygen ranged from 70.7% at 1700 r to 1.6% at 24 000 r. Dose-action survival curves for eggs irradiated in metaphase were exponential regardless of the gas in which irradiation took place. Dose-action curves for eggs irradiated in prophase were linear for the x-ray doses given. Cytological studies of eggs irradiated with 1000 r during meiotic 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.

For details, see Dissertation 4939, Pennsylvania Univ., Philadelphia, 1953.

1394 Kenworthy, W. THE EFFECT OF OXYGEN CONCENTRATION OF THE DOSE-ACTION SURVIVAL CURVES OBTAINED FOR HABROBRACON EGGS IRRADIATED DURING MEIOTIC PROPHASE AND METAPHASE. Amer. Nat. 90, 85 (1956) 119-26.

Studies of total embryo lethals induced in 4570 eggs x-rayed in N_2, air and O_2 during meiotic metaphase with doses ranging from 396 r to 2450 r were made. The N_2 series differed very significantly from the air and O_2 series with a maximum difference of 48.5% at one dose. Similar studies were made of 4846 prophase eggs x-rayed in N_2, air, and O_2 with doses ranging from 2100 r to 44 100 r. Again the nitrogen series differed significantly from the air and O_2 series with the maximum differences reaching 52.0% at one dose. The oxygen effect appears to be of the same magnitude in metaphase and prophase eggs despite a considerable difference in the x-ray dose necessary to induce lethality in each of these two stages. This similarity is believed by the author to support the initial damage hypothesis of O_2 action. (auth.)

1395 LaChance, L. E. THE ROLE OF CHELATION IN THE PRODUCTION OF X-RAY INDUCED DOMINANT LETHALS IN HABROBRACON. p. 156 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

Four groups of virgin Habrobracon wasps, comprising (1) controls, (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 unmated 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 oögonial mitosis at the time of treatment were identifiable on the basis of ovariole morphology. Females were allowed only a single meal of the chelating agent, 0.1 M EDTA as the disodium salt. In those groups which were fed the chelator and then irradiated, the dominant lethality was much greater than it was in either the irradiated or the EDTA-fed groups. It was also 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 abstr.)

* LaChance 1958 - [1281]

1396 LaChance, L. E. THE EFFECT OF CHELATION AND X-RAYS ON FECUNDITY AND INDUCED DOMINANT LETHALS IN HABROBRACON. Radiation Res. 11 (1959) 218-28.

The effects of ingested 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. (auth.)

1397 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-IRRADIATION. Diss. Abstr. 19, 11 (1959) 2723.

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 than 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 oöcytes and oögonial cells. After a radiation dose of 2500 r, Habrobracon females undergo a period of temporary sterility followed by a period of marked 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 wholemounts 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 abstr.)

1398 Luce, W. M., Quastler, H., Lanzl, E. F. BIOLOGICAL EVALUATION OF 20 MILLION VOLT ROENTGEN RAYS. V. BAR EFFECT IN DROSOPHILA. Amer. J. Roentgenol. 64, 6 (1950) 963-7.

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/r, while that of the 100 and 200 kV radiation for different doses, different dose rates, and different control facet numbers was 0.0141 facets/r. The ratio of the mean efficiency of the 20 MeV to that of the 100 and 200 peak kV x-rays was 0.0119/0.0141 or 0.85. All dose measurements were made with a single thimble chamber. (EM XIV (5): 1796, 1951)

1399 Lüers, H. MEGAPHEN-VORBEHANDLUNG UND STRAHLENINDUZIERTE MUTATIONSRATE BEI DROSOPHILA MELANOGASTER (Megaphen treatment and radio-induced mutation rates in Drosophila melanogaster). Atompraxis 5 (1959) 288-90. (In German)

Megaphen, administered alone or in combination with other substances, prevents somatic radiation injury to a recognizable extent, but does not reduce the radiation-induced mutation rate in Drosophila. X-radiation was used. (auth.)

* Lüning and Hannerz 1952 - [1285]

1400 Lüning, K. G. EFFECT OF OXYGEN ON IRRADIATED MALES AND FEMALES OF DROSOPHILA. Hereditas 40, 3-4 (1954) 295-312.

The protective action of low O_2 concentrations during irradiation is not fully understood; a breakage and a reunion hypothesis have been proposed. The present study deals with an analysis of O_2 concentration on the rate of chromosome aberrations induced either in Drosophila sperm inseminated the 1st d as compared to the 2nd and 3rd d after irradiation of newly hatched males, or in oöcytes. The results are discussed, and it is concluded that the variations in the breakability in various stages of spermiogenesis can not depend on variations in the O_2 concentration. In oöcytes irradiated in air less dominant lethals and more minute rearrangements are induced than in spermatozoa. The effect of anoxia is much greater in females than in males. The effect of the O_2 concentration during irradiation is discussed and a scheme of levels of possible effect, is presented.

1401 Lüning, K. G. THE EFFECT OF ANOXIA ON THE RATES OF X-RAY INDUCED MUTATIONS IN DROSOPHILA MELANOGASTER. p. 350-4 in "Progress in Radiobiology. Proceedings of the 4th International Conference on Radiobiology, Cambridge 14-17 Aug. 1955". Mitchell, J. S., Holmes, B. E., Smith, C. L., eds. London, Oliver and Boyd. 1956.

Muller-5 males were irradiated (3240 r) in air or nitrogen atmospheres and mated to y w sn females. F_1 offspring were analyzed, and the results discussed. The rates of recessive lethals do not show the same variations as the rates of the break-dependent aberrations, facts in favour of a double origin of recessive lethals: intergenic (break-dependent) and intragenic (seemingly break-dependent). It is concluded that both chromosome breaks and intragenic changes are affected to a similar degree of anoxia.

* Lüning and Jonsson 1958 - [953]

* Lüning et al. 1958 - [1289]

1402 Murphy, W. W. THE EFFECT OF OXYGEN ON THE FREQUENCY OF X-RAY INDUCED MUTATIONS IN HABROBRACON SPERM. Biol. Bull. 107 (1954) 301.

Females were mated to males irradiated with a sublethal dose of x-rays, in air or in nitrogen (4234 r in 100 s). The results are given in terms of hatchability of F_1 eggs, dominant lethal rate, number of females produced/day/female, recessive embryo lethals per F_1 female after irradiation of sperm and recessive post-embryo lethals carried, and visible mutations. The differences (when significant) were smaller than for Habrobracon eggs irradiated under comparable conditions. (from abstr.)

(Paper presented at Marine Biological Laboratory)

1403 Nakao, Y. THE EFFECT OF GLUTATHIONE UPON THE VISIBLE MUTATION RATES INDUCED BY X-RAYS IN THE SILK WORM. Jap. J. Genet. 32, 8 (1957) 253. (In Japanese)

* Oster 1957 - [919]

1404 Oster, I. I. INTERACTIONS BETWEEN IONIZING RADIATION AND CHEMICAL MUTAGENS. Z. indukt. Abstamm. -VererbLehre 89 (1958) 1-6.

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 translocations is synergistic. The ends of chromosomes broken by x-rays, mustard gas, and urethane are as capable of rejoining with those produced by the same agent as the x-ray produced ones are of rejoining with those produced by either mustard gas or urethane to form chromosomal disarrangements. (auth. summary)

* Ott 1959 - [919]

* Plaine and Glass 1952 - [1348]

* Plaine 1955 - [1349]

1405 Plaine, H. L. THE COUNTERACTION BY CYSTEINE OF THE EFFECTS OF X-RAYS AND OF TRYPTOPHAN ON THE ACTION OF SPECIFIC SUPPRESSOR SYSTEMS IN DROSOPHILA MELANOGASTER. Cancer Res. 15 (1955) 151-8.

L-Cysteine was fed to larvae carrying both a suppressor-erupt and a suppressor-tumour system to test its effect in combination with x-ray treatments and with supplementary L-tryptophan in the diet. Cysteine itself had no effect on erupt eyes or on the incidence of melanotic tumours. Fed before or after x-ray treatment, cysteine greatly reduced the radiation effect which blocks the action of the suppressor genes and thus engenders both tumours and erupt eyes. Cysteine was more effective in counteracting the erupt eye effect when fed before the x-ray treatment; but it appeared to be more effective against the tumourigenic 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 tumours 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 tumours from 63% to 24% and in the incidence of erupt eyes from 52% 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 O_2 or cysteine is strikingly like that of x-rays with O_2 and cysteine. This might imply the operation of a similar mechanism in these cases. (auth.)

1406 Ray-Chaudhuri, S. P., Saha, A. K. ON THE PROTECTIVE ACTION OF VERSENE AGAINST RADIATION DAMAGE IN GRASSHOPPER CHROMOSOMES. Proc. nat. Inst. Sci. India Section B: Biol. Sci. 26, Suppl. (1960) 6-10.

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 meiotic anaphase cells of the grasshopper, Gesonula punctifrons. In the controls (treated with 0. 67 percent saline plus 86 r of x-rays), 10. 18 ± 0. 27 bridges were recorded as compared to 8. 29 ± 0. 61 percent in the treated series (10^{-3} M versene solution in 0. 67 percent saline plus 86 r of x-rays). The unirradiated versene treated group showed no bridges in 801 first anaphase cells. It was concluded that versene is a definite though feeble protector of radiation-induced chromosome breaks in our material. (auth.)

1407 Read, J. THE INFLUENCE OF OXYGEN ON THE X-RAY PRODUCTION OF CHROMOSOME BREAKS IN DROSOPHILA. J. Genet. 52, 3 (1954) 473-9.

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 is affected by oxygen concentration in the atmosphere in which the flies are irradiated. The data agree with Haldane and Lea's (1947) mathematical theory if 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 H_2O_2) which can cause a break if it diffuses to the chromosome in sufficient concentration. (BA 31: 191, 1957)

1408 Shaw, E. I. PROTECTION BY SODIUM HYDROSULFITE AGAINST X-RAY-INDUCED MITOTIC INHIBITION IN GRASSHOPPER NEUROBLAST. Proc. Soc. exp. Biol., N. Y. 92 (1956) 232-6.

In neuroblast cultures of the embryo of the grasshopper Chortophaga viridifasciata (De Geer) protection against x-ray-induced mitotic inhibition is conferred by pretreatment with sodium hydrosulfite. A concentration of 10^{-2}M sodium hydrosulfite 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 at 32 r is 8. The rate of recovery is the same in the cultures that received 32 r and that were also pretreated with 10^{-2}M sodium hydrosulfite as in those that were irradiated but received no pretreatment. The earlier recovery of the pretreated cultures is accounted for on the basis of less demonstrable inhibition of mitotic activity by the radiations. The primary damage responsible for mitotic inhibition at low doses, and at least partially at high doses, may be due to the oxidation of intracellular components by HO_2 or similar oxidizing radicals whose formation is dependent on the presence of oxygen during irradiation. (auth. summary)

1409 Sobels, F. H. CHEMICAL STEPS INVOLVED IN THE PRODUCTION OF MUTATIONS AND CHROMOSOME ABERRATION BY X-RADIATION AND CERTAIN CHEMICALS IN DROSOPHILA. State Univ. Utrecht, Institute of Genetics, survey of studies from 1954-1956, 6 p.

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 dihydroxydimethyl 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 Intern. J. Radiation Biol. 2, 1 (1960) 68-90)

1410 Sobels, F. H. THE EFFECT OF CYANIDE AND AZIDE ON THE RATE OF X-RAY INDUCED MUTATIONS IN DROSOPHILA. Z. indukt. Abstamm. -VererbLehre 86 (1955) 399-409.

Drosophila males were injected with a 0.008 M solution of potassium cyanide prior to x-radiation with doses varying from 980-2400 r. Compared to the controls, which were only x-rayed, the frequency of sex-linked lethals after cyanide pretreatment 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 pretreated irradiated germ cells. (auth. summary)

1411 Sobels, F. H. ORGANIC PEROXIDES AND MUTAGENIC EFFECTS IN DROSOPHILA. EFFECT OF PRE-TREATMENT WITH DIHYDROXYDIMETHYL PEROXIDE ON THE RATE OF MUTATIONS INDUCED BY X-RAYS. Nature 177 (1956) 980-2.

A particular stage of spermatogenesis which is characterized 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 a reasonable assumption 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.

1412 Sobels, F. H. THE EFFECT OF FORMALDEHYDE ON THE MUTAGENIC ACTION OF X-RAYS IN DROSOPHILA. Experientia 12 (1956) 318-21.

Drosophila males were exposed to 1700-2200 r of x-rays, after injections of low doses (0.28 mm^3 of 0.033-0.050 M) of formaldehyde. The incidence of sex-linked recessive lethals was determined by the Muller-5 method. Irradiation was at 100-kV potential and 5 mA, at 244 r/min, 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 evidently 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 sensitize the chromosomes to x-rays.

1413 Sobels, F. H. THE POSSIBLE ROLE OF PEROXIDES IN RADIATION AND CHEMICAL MUTAGENESIS IN DROSOPHILA. p. 449-54 (disc. p. 454-6) in "Advances in Radiobiology. Proceedings of the 5th International Conference on Radiobiology, Stockholm 15-19 Aug. 1956". de Hevesy, G. C., Forssberg, A. G., Abbatt, J. D., eds. London, Oliver and Boyd. 1957.

Injection of 0.033 M formaldehyde prior to irradiation with 1700 r caused, from the 2nd day onwards a significant enhancement of the mutation rates 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 0.0138 M of dihydroxydimethyl peroxide also caused a pronounced enhancement of the mutagenic effect of x-rays. A comparison with the effects of cyanide and azide shows that all three 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 peroxide in the cell, suggests that the formation of peroxides may account for at least part of the genetic effects of x-rays in Drosophila.

1414 Sobels, F. H. PRESUMPTIVE INDICATION OF RADIATION-PRODUCED PEROXIDE AS SHOWN BY ITS GENETIC EFFECTS IN DROSOPHILA. Actions Chim. et Biol. des Radiations 4 (1958) 73-85.

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 590 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 rearrangements, but are probably caused by catalase inhibition leading to greater accumulations of mutagenic peroxide at the high than at the low dose rate. This peroxide 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 53: 2302h, 1959)

1415 Sobels, F. H. PRESUMPTIVE INDICATION OF RADIATION-PRODUCED PEROXIDE AS SHOWN BY ITS GENETIC EFFECTS IN DROSOPHILA. p. 73-83 (disc. p. 83-5) in "Les Peroxydes Organiques en Radiobiologie. Actions chimiques et biologiques des radiations. Collection dirigée par M. Haissinsky", 4e série. Latarjet, R., ed. Paris, Masson et Cie. 1958.

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 than at low dose rates. The fact that catalase inhibition was still effective 6 min after irradiation was taken as evidence that short-lived radiation-produced OH and HO_2 radicals, and H_2O_2 in an excited state presumably are not the active mutagenic agents. These findings could also explain that in earlier experiments, even at low dose rates, cyanide and azide, if administered as pre-treatment, enhance the mutagenic effects of irradiation. (auth. summary)

1416 Sobels, F. H. THE EFFECT OF PRETREATMENT WITH CYANIDE ON RADIOSENSITIVITY IN NITROGEN AND OXYGEN. Drosophila Inform. Serv. 32 (1958) 159-61.

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 affects spermatids is in keeping with the hypothesis, because it has been shown that more O_2 is available within spermatids than within mature sperm.

1417 Sobels, F. H. CHEMICAL STEPS INVOLVED IN THE PRODUCTION OF MUTATIONS AND CHROMOSOME ABERRATIONS BY X-IRRADIATION IN DROSOPHILA. I. THE EFFECT OF POST-TREATMENT WITH CYANIDE IN RELATION TO DOSE-RATE AND OXYGEN TENSION. Intern. J. Radiation Biol. 2, 1 (1960) 68-90.

Post-treatment with hydrocyanic 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 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 spermatids. 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 N_2, as in O_2. 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 seems a metabolic process, possibly connected with respiratory energy. Injury to this repair system is independent of oxygen tension, and the reparable fraction of the initial damage after radiation in N_2 is equal to that after radiation in O_2.

A brief report appeared under "Post-radiation modification of the mutation rate in Drosophila by cyanide" in Acta Physiol. -Pharmacol. Neerlandica 9, 1960.

1418 Sobels, F. H. EFFECTS OF POST-TREATMENT WITH CYANIDE ON THE INDUCTION OF MUTATIONS BY X-RAYS IN DROSOPHILA. (abstr.) Intern. J. Radiation Biol. 2, 2 (1960) 230.

Post-treatment with hydrocyanic acid results in a significant increase of the mutation frequency in spermatids, if x-radiation is delivered at a dose-rate of 2200 r/min (intense radiation), but not after a dose rate of 590 r/min (dilute radiation). In the absence of cyanide no dose-rate effect was observed. Following dilute radiation, the frequency of translocations in spermatids, unlike that of lethals, is significantly increased by cyanide. Various interpretations are proposed.

* Sumarokov 1958 - [1265]

1419 Taboada, O. SOME EFFECTS OF RADIANT ENERGY ON THE BEETLES, TRIBOLIUM CONFUSUM, DUV. SITOPHILUS GRANARIUS (L.), AND ACANTHOSCELIDES OBTECTUS (Say). M. S. Thesis, Dept. of Entomology, Michigan State Coll., East Lansing, 1953.

The effects of infra-red 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)

1420 Tahmisian, T. N., Adamson, D. M. THE EFFECT OF ANOXIA ON X-RAY-INDUCED INJURY IN MELANOPLUS DIFFERENTIALIS EMBRYOS. Anat. Record 108 (1950) 516.

Melanoplus differentialis grasshopper embryos placed in an atmosphere of N_2/CO_2 (95%/5%) for 24 h developed normally. If these anoxic embryos are irradiated at 25 000 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 N_2/CO_2, show development unlike those irradiated in air. Thus, they undergo blastokinesis, increase in size, resting nuclei appear normal, respiration is normal, mitosis resumes, the embryos grow, and the oxidative enzyme due to x-radiation does not appear. They do not hatch, however. Since any O_2 which is dissolved in the egg is theoretically used up in ½ h the irradiation effect on these embryos under N_2/CO_2 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.)

(Abstract of paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio 27-30 Dec. 1950)

(An earlier report appeared on p. 55-8 in ANL-4488, Argonne National Lab., Lemont, Ill. Progress Report, 4 July 1950. An increase of about 80% in hydroquinone oxidase over a period of 14 d was reported for diapause eggs exposed to 25 000 r of x-rays in normal room atmosphere.)

1421 Tahmisian, T. N. STUDIES OF THE BIOLOGICAL BASIS OF RADIOSENSITIVITY. UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 8/P/83. 11 (1956) 256-9.

Grasshopper embryos irradiated in air undergo negative growth. The degree of negative growth is less if the embryos are irradiated in 20% O_2: 80% 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 and during irradiation. Eggs that have high tetrazolium-reducing 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

irradiation protection is dependent upon the hydrogen and electron transfer of tissues and cells. (Essentially auth. summary)

1422 Traut, H. ZUM PROBLEM DER WIRKUNG VON VERFÜTTERTEM EISENSACCHARAT AUF DIE DURCH RÖNTGENSTRAHLEN 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.-VererbLehre 91, 3 (1960) 325-32. (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 (translocations, state of maturity of the irradiated germ cells, feeding of iron-II-gluconate) 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.

1423 Vasterling, H. W. VERGLEICH DER WIRKUNG VON RÖNTGENSTRAHLEN UND STICKSTOFFLOST AUF ZWEISTÜNDIGE DROSOPHILA EIER (Comparative studies on the effect of x-rays and that of nitrogen mustard on 2-h Drosophila eggs). Strahlentherapie 89, 2 (1952) 265-8. (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 72 h exposure at a constant temperature). The lethal ratio of various x-ray doses was also established. As a half-value dose (LD_{50}), 14-15 mg nitrogen mustard is approximately equivalent to 195 r; 5 mg nitrogen mustard (6.4% lethality) is equivalent to 50 r; 30 mg nitrogen mustard corresponds with 400 r (lethal ratio 94 and 87%, respectively). The use of higher concentrations than 30 mg nitrogen mustard does not increase the effect. (EM XIV (8): 15, 1954)

1424 Whiting, A. R. FREQUENCIES OF DOMINANT AND RECESSIVE LETHALS INDUCED IN HABROBRACON EGGS BY X-RAYS IN AIR AND IN NITROGEN. Genetics 38 (1953) 701.

Eggs x-rayed in late metaphase I show high rate of terminal deletions correlated with dominant lethal effects. Recessive lethal rate is low. Chromosomes in this stage appear to be under tension and are not in contact. Dominant lethal rate may represent total original breakage because of tension while recessive lethals may result from minute changes within chromosomes. Eggs (n) from irradiated unmated females which hatch have no lethals. Surviving daughters (2n) from females mated to untreated males, when bred unmated, 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 act before hatching. Unmated females were exposed to 1100 r in a current of air or of nitrogen, the latter during irradiation only, about 3 min. Results are given. The 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 1953 meeting of the Genetics Society of America, Boston, Mass., 28-30 Dec. 1953)

1425 Whiting, A. R. THE EFFECTS OF OXYGEN ON THE FREQUENCY OF X-RAY-INDUCED MUTATIONS IN HABROBRACON EGGS. Genetics 39 (1954) 851-8.

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 postembryo lethals, and visible mutations were recorded. All types were reduced at the same relative frequency in nitrogen, 500 r in air producing almost identical percentages of mutations as 1100 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 IRRADIATED HABROBRACON EGGS AND SPERM TO ANOXIA, AND THEIR THEORETICAL SIGNIFICANCE. Radiation Res. 3 (1955) 356-7, abstr. 143.

Eggs in first meiotic 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 postembryo lethal and visible mutations were recorded. In all, 96301 eggs were observed. In the nitrogen series, dominant

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 affords evidence for the breakage hypothesis, since, if the reunion hypothesis were correct as an explanation of lowered 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 (water?) 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 Whiting, A.R., Murphy, Wm.E. DIFFERENCES IN RESPONSE OF IRRADIATED EGGS AND SPERMATOZOA OF HABROBRACON TO ANOXIA. J. Genetics 54, 2 (1956) 297-303.

All types of x-ray-induced mutations of Habrobracon eggs in prophase I and MI and in spermatozoa were fewer in atmospheres of nitrogen than in atmospheres of air. Dominant lethal mutations, apparently associated with isochromatid breakage and lateral sister union and with tension (conditions which prevent restitution) decreased in MI 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 spermatozoa may have resulted from differences in amounts of cytoplasm and dissolved oxygen. The data appear to favour the "breakage" hypothesis, rather than the "reunion" hypothesis, to explain the protective effect of anoxia on x-ray-induced chromosome aberrations. (BA 31: 19514, 1957)

1428 Wolff, S., Lindsley, D. L. EFFECT OF OXYGEN TENSION ON THE INDUCTION OF APPARENT XO MALES IN DROSOPHILA. Genetics 45 (1960) 939-47.

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 1000 r of x-rays (where Lüning and co-workers had reported saturation), oxygen rather than a cellular component limits the amount of damage that may accrue. 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 and 0.2 atmosphere but is sensitive to 1.0 vs. 0.2 atmosphere of oxygen. This model is similar to the one proposed to account for the effect of oxygen tension on induced chromosome breakage and rejoining in Vicia faba, in which a rejoining system is extremely sensitive to oxygen tension, whereas breakage is less sensitive. (from auth. summary)

1429 Yost, H. T., Jr., Benneyan, R. N. THE EFFECTS OF COMBINED RADIATIONS ON CROSSING OVER IN DROSOPHILA MELANOGASTER. Genetics 42 (1957) 147-60.

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 γ-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 chromosomes.

1430 Young, W. J., Yost, H. T., Jr., Ives, P. T., Levine, R. P. THE EFFECT OF PRETREATMENT WITH INFRA-RED RADIATION ON THE X-RAY INDUCED SEX-LINKED RECESSIVE LETHAL AND VISIBLE MUTATION RATE IN DROSOPHILA MELANOGASTER. Proc. nat. Acad. Sci., Washington 39 (1953) 488-95).

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. Crossing over 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. (auth. summary)

1431 Atwood, K. C. ABERRATION FREQUENCIES IN IRRADIATED POPULATIONS. Amer. Nat. 88 (1954) 379-80.

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 thus be somewhat greater than Paget estimated on the basis of equal rates of origin.

1432 Auerbach, S. I., Crossley, D. A., Jr., Engelmann, M. D. EFFECTS OF GAMMA RADIATION ON COLLEMBOLA POPULATION GROWTH. Science 126, 3274 (1957) 614.

Experiments were started with 61 reproducing population units of 10 individuals each of Proisotoma minuta Tull. 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 bi-daily 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 this threshold period, i.e. a lag effect.

(An earlier abstract was published in Bull. ent. Soc. Amer. 2, 3 (1956) 17, abstr. 24, by Auerbach and Engelmann)

* Bonnier 1957 - [974]

* Bonnier and Jonsson 1957 - [975]

1433 Bonnier, G., Jonsson, U.-B., Ramel, C. SELECTION PRESSURE ON IRRADIATED POPULATIONS OF DROSOPHILA MELANOGASTER. Hereditas 44, 2-3 (1958) 378-406.

A study (stressed 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, sterility of males, larval competitions, and on the number and spread into the populations of lethal genes) have not shown any clear-cut differences between the populations.

1434 Bonnier, G., Jonsson, U.-B., Ramel, C. EXPERIMENTS ON THE INFLUENCE OF SELECTION PRESSURE ON IRRADIATED POPULATIONS OF DROSOPHILA MELANOGASTER. 2nd UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 15/P/169. 22 (1958) 322-4.

Within each separate population (as defined) all flies of each generation were irradiated under a common x-ray beam with 1500 r. The techniques are described. It was attempted to collect 5000 - 6000 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.

1435 Bonnier, G., Jonsson, U.-B., Ramel, C. ADDITIONAL EXPERIMENTS ON IRRADIATED POPULATIONS OF DROSOPHILA MELANOGASTER. Hereditas 45, 2-3 (1959) 441-8.

This paper is a continuation of work reported earlier by the authors (Hereditas 44 (1958) 378-406), 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.

1436 Borstel, R. C. von. POPULATION CONTROL BY RELEASE OF IRRADIATED MALES. Science 131 (1960) 878, 880-2.

The note is a searching comment on an article by Knipling (Science 130 (1959) 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 monogamy or polygamy exist in the insect population. Data from work on Drosophila, Habrobracon and Callitroga hominivorax are cited.

1437 Buzzati-Traverso, A. A., Scossiroli, R. E. X-RAY-INDUCED MUTATIONS IN POLYGENIC SYSTEMS. 2nd UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 15/P/588. 22 (1958) 293-7.

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 those variants which bestow a higher fitness on 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 of 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 trait, may be assumed. The origin of new genetic variability is discussed.

(This paper was also published in Progr. nucl. Energy Ser. VI, Biol. Sci. 2 (1959) 249-57, Bugher, J. G., et al., eds. London, Pergamon Press. 1959)

1438 Carson, H. L. EFFECT OF IRRADIATION ON ARTIFICIAL POPULATIONS UNDER STRONG NATURAL SELECTION. (abstr.) Genetics 44 (1959) 503.

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 numbers 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 relaxation of radiation, the experimental populations quickly rose again to the level of the controls but did not surpass them. (from abstr.)

* Clayton and Robertson 1955 - [987]

1439 Cunha, A. B. da, Toledo, J. S. de, Pavan, C., Souza, H. L. de, Melara, H. E., Gabrusewycz, M. R., Gama, M. R., Pires des Camargo, M. L., Mello, L. C. de. ANALYSIS OF EFFECTS OF NATURAL AND RADIATION-INDUCED LETHALS AND OF THEIR FREQUENCIES IN DROSOPHILA WILLISTONI. 2nd UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 15/P/2281. 22 (1958) 3303.

(Cf. Progr. nucl. Energy, Series VI, Biol. Sci. 2 (1959) 359-63)

1440 Cunha, A. B. da, Toledo, J. S. de, Pavan, C., Souza, H. L. de, Melara, H. E., Gabrusewycz, M. R., Gama, M. R., Pires de Camargo, M. L., Mello, L. C. de. A COMPARATIVE ANALYSIS OF THE EFFECTS OF NATURAL AND OF RADIATION-INDUCED LETHALS IN HETEROZYGOUS INDIVIDUALS AND OF THEIR FREQUENCIES IN NATURAL POPULATIONS OF DROSOPHILA WILLISTONI. p. 63 in "Proceedings of the 10th International Congress on Genetics, Montreal 1958", Vol. 2. Toronto, University of Toronto Press. 1958.

(Abstract of paper presented at the Congress)

(Cf. Progr. nucl. Energy, Series VI, Biol. Sci. 2 (1959) 359-63)

1441 Cunha, A. B. da, Toledo, J. S. de, Pavan, C., Souza, H. L. de, Melara, H. E., Gabrusewycz, M. R., Gama, M. R., Pires de Camargo, M. L., Mello, L. C. de. A COMPARATIVE ANALYSIS OF THE EFFECTS OF NATURAL AND OF RADIATION-INDUCED LETHALS IN HETEROZYGOUS INDIVIDUALS AND OF THEIR FREQUENCIES IN NATURAL POPULATIONS OF DROSOPHILA WILLISTONI. Progr. nucl. Energy, Ser. VI, Biol. Sci. 2 (1959) 359-63.

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.

1442 Gregg, T.G. EXPERIMENTAL POPULATIONS OF DROSOPHILA ANANASSAE, DERIVED FROM IRRADIATED NATURAL POPULATIONS. Univ. Tex. Publ. 5914 (1959) 207-24.

(See Diss. Abstr. 19 (1959) 2217)

1443 Gregg, T.G. (Univ. Texas, Austin) STUDIES ON EXPERIMENTAL POPULATIONS OF DROSOPHILA ANANASSAE DERIVED FROM IRRADIATED NATURAL POPULATIONS. Diss. Abstr. 19 (1959) 2217.

Subpopulations of D. ananassae taken from populations on various atolls in the Marshall Islands in 1956 and 1957 were maintained in the laboratory in different types of experimental populations. These and a series of experiments are discussed. The results are taken as strong evidence that the low viability levels observed elsewhere (Bikini and Rongelap populations, 1955*) were actually the results of radiation from the thermonuclear tests 18 months previously and not due to normal population fluctuations.

* Stone et al "Genetic studies of irradiated natural populations of Drosophila". Univ. Tex. Publ. 5721 (1957) 261-316.

1444 Knipling, E.F. POPULATION CONTROL BY RELEASE OF IRRADIATED MALES. Science 131 (1969) 882.

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

(See Science 130 (1959) 902, and ibid 131 (1960) 878).

1445 Paget, O.E. A CYTOLOGICAL ANALYSIS OF IRRADIATED POPULATIONS. Amer. Naturalist 88 (1954) 105-7.

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.

1447 Prout, T. GENETIC DRIFT IN IRRADIATED EXPERIMENTAL POPULATIONS OF DROSOPHILA MELANOGASTER. Genetics 39, 4 (1954) 529-45.

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) also irradiated; and one was a large population receiving no treatment. The effect of genetic drift operating in the small population was demonstrated by determining the allelism of the lethals taken from the three populations and by analyzing the lethal accumulation curves in the populations. Also three population parameters 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 (A) the small population might have a genetically effective size less than its absolute size, and (B) 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. (auth.)

1448 Ramel, C., Bonnier, G., Jonsson, U.-B. SELECTION PRESSURE ON IRRADIATED POPULATIONS OF DROSOPHILA MELANOGASTER. Radiation Res. 9 (1958) 170.

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 strength of selection 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 includes more than 25 flies per group. After the emergence of a new generation all flies are irradiated by an acute x-ray dose of 1.5 kr. An effect of selection pressure is strongly indicated by the differences in the ease 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 quicker in the populations with strong selection pressure than in those with low pressure. When testing irradiated second chromosomes a marked dominant effect in viability was found.

(Abstract of paper presented at the Intern. Congr. of Radiation Res., Burlington, Vermont 10-16 Aug. 1958)

1449 Scossiroli, R. E. EFFECTIVENESS OF ARTIFICIAL SELECTION UNDER IRRADIATION OF PLATEAUED POPULATIONS OF DROSOPHILA MELANOGASTER. Un. int. Sci. biol. Publ. Series B 15 (1954) 42-66, Symposium on Genetics of Population Structure.

Treatments with x-rays have made possible further progress in a selected line which had reached a plateau, as the result of increased variability in the irradiated lines. The progress of the selected trait is accompanied by an increase in sterility and decrease in fertility, mostly due to some effect related to the selected response. A small number of x-ray treatments of 3000 r each can induce so much variability that under the selection pressure applied there is no difference between the lines in which the x-ray treatments have been suspended after 6 applications and those in which the treatments have been continued. It seems that the artificial selection pressure applied which would otherwise result in continuous changes in the genetic composition of the population, is opposed by natural selection so that a condition of genetic homeostasis is attained.

1450 Scossiroli, R. E. SELEZIONE ARTIFICIALE PER UN CARATTERE QUANTITATIVO IN POPOLAZIONI DI DROSOPHILA MELANOGASTER IRRADIATIO CON RAGGI X (Artificial selection for a quantitative trait in Drosophila melanogaster population treated with x-rays). CNB-4, Comitato Nazionale per le Richerche Nucleari, Milan. 1959, 218 p. (In Italian)

Selection for high and low numbers of sternopleural hairs was conducted on x-irradiated plateaued lines of Drosophila to determine if x-irradiation can induce new variability for further selection. The results showed that in selection for high numbers of hairs, treatments with high doses of x-radiation (3000 r every other generation) were effective in producing a large selection response. Selection in non-irradiated lines were almost ineffective. The selection response in irradiated lines is associated with an increase of genetic variability. In the irradiated lines a strong reduction of fitness (increase of sterility and decrease of fertility) is observed. This decrease in the fitness is caused only in part by specific mutations induced by x-radiation; it is associated with the response to the intense selection applied. After a relaxation of the selection and a suspension of the treatment, there is a regression of the average value of the selection characteristic which is stabilized at a higher level, however, than that at the beginning of the experiment. An improvement in the fitness is also observed. The importance of polygene mutability, and the importance of the results obtained for plant and animal breeding are discussed. (tr-auth.)

1451 Scossiroli, R. E. ON THE RELATIVE ROLE OF MUTATION AND RECOMBINATION IN RESPONSES TO SELECTION FOR POLYGENIC TRAITS IN IRRADIATED POPULATIONS OF D. MELANOGASTER. Intern. J. Radiation Biol. 1 (1959) 61-9.

X-ray treatments are a very efficient tool for inducing polygenic mutation and therefore additive genetic variability for polygenic traits in Drosophila. Artificial selection can make use of the new genetic variability. X-ray-induced increase in recombination rates does not seem to be an important factor in determining the observed effects, at least in the described experiments. (auth.)

1452 Stern, C. RADIATION AND POPULATION GENETICS. p. 206-28 in "Radiation Biology and Medicine", Claus, W. D., ed. Reading, Mass. Addison-Wesley Publ. Co., Inc. 1958, 961p.

Gene effects in different individuals of a population are discussed, the heterozygosity of populations, and the genetics of irradiated experimental populations. Results obtained with Drosophila are used a great deal for illustration. General bibliography: 66 references.

1453 Stone, W. S., Wheeler, M. R., Spencer, W. P., Wilson, F. D., Neuenschwander, J. T., Gregg, T. G., Seecof, R. L., Ward, C. L. GENETIC STUDIES OF IRRADIATED NATURAL POPULATIONS OF DROSOPHILA. Univ. Tex. Publ. No. 5721 (1957) 260-316.

1454 Stone, W. S., Wilson, F. D. GENETIC STUDIES OF IRRADIATED NATURAL POPULATIONS OF DROSOPHILA. II. 1957 TESTS. Proc. nat. Acad. Sci., Washington 44 (1958) 565-75.

Genetic analyses were made of irradiated and control isolated populations of D. ananassae from the Pacific Proving Ground area, others of the Marshall Islands, and Ponape.

1455 Stone, W. S., Wilson, F. D. GENETIC STUDIES OF IRRADIATED NATURAL POPULATIONS OF DROSOPHILA. IV. Univ. Tex. Publ. No. 5914 (1958) 223-34.

1456 Wallace, B. AUTOSOMAL LETHALS IN EXPERIMENTAL POPULATIONS OF DROSOPHILA MELANOGASTER. Evolution 4 (1950) 172-4.

Preliminary work indicating that a large proportion of induced lethals in the second chromosome of D. melanogaster are incompletely recessive is reported. Three experimental populations of D. melanogaster were analyzed for lethal second chromosomes. The original flies of two of these populations were treated with x-rays. Frequencies of lethals in experimental populations is presented in tabular form. Data indicate that less than one-half of the original induced lethals persist through six generations. (NSA 6: 8, 1952)

(See also AECU-1716, Long Island Biological Assn., Biological Lab., Cold Spring Harbor, N.Y. 6p)

1457 Wallace, B. GENETIC CHANGES WITHIN POPULATIONS AFTER X-IRRADIATION. Genetics 36 (1951) 612-28.

Genetic analyses were made of populations of Drosophila melanogaster, known to carry second chromosomes free of lethals and drastic subvitals, and which were subjected to single x-ray treatments. The recessive lethals of population (1) (parental males had received 1012.5 r) decreased from an original 18.3% to 10.1% in about 4 generations, and then increased at a rate comparable to that of the control. The early elimination of lethals from (1) indicated a selective disadvantage of heterozygotes of 0.5, and was adequately explained by lethal-translocation association. Analyses of lethals, semi-lethals, average viabilities of flies homozygous for "normal" chromosomes, and variances of the array of "normal" viabilities indicate that changes occurred at a more rapid rate in (1) than in the control. It has been suggested that this was the result of a greater number of possible gene combinations in the irradiated population and that gene mutation was supplemented by gene recombination. The discussion touches briefly on general problems of irradiated populations. (from auth. summary)

(Also published as AECU-1107, Long Island Biological Assn., Biological Lab., Cold Spring Harbor, N.Y. 26p)

1458 Wallace, B. STUDIES OF POPULATIONS EXPOSED TO RADIATION. (abstr.) Science 115 (1952) 487.

Studies are reported on experimental populations of Drosophila melanogaster exposed to continuous γ-radiation or to a single massive dose of x-radiation. The analyses were primarily of two types: determination of the frequencies of second chromosomes carrying lethal and semilethal gene mutations in the several populations, and estimation by various techniques of the adaptive values or well-being of the populations. The findings are discussed. A lower adaptive value is indicated in those populations that have received the most chronic irradiation. The genetic structures of populations appear to be under constant review by natural selection; well-adapted structures are maintained in spite of mutagenic forces operating counter to natural selection.

1459 Wallace, B. STUDIES ON IRRADIATED POPULATIONS OF DROSOPHILA MELANOGASTER. J. Genet. 54 (1956) 280-93.

Previously reported results of genetical analyses of irradiated populations of D. melanogaster are summarized and extended. The Cy L and Cy L-Pm techniques were used to test 2d chromosomes for lethals. Data for nearly 150 generations demonstrated that the average viability of individuals carrying random combinations of chromosomes from each of 2 populations may not reflect the average effect of these chromosomes on the viability of homozygous individuals. The accumulation within an irradiated population of chromosomes deleterious when homozygous need not result in a generation-by-generation decline in viability of heterozygous individuals. It is suggested that the seemingly deleterious chromosomes found within the populations are retained by virtue of their characteristics in heterozygous individuals. In general, it is suggested that any new mutation retained by a population is retained because it is favourable in its heterozygous carriers. There is no necessity that the mutations be favourable as well when homozygous. By definition, the majority of mutations in a population should be heterotic within the genetic system of that population. (BA 31: 19588, 1957)

(A paper on the same topic also appears on p. 201-4 in "Progress in Radiobiology." Proceedings of the 4th International Conference on Radiobiology, Cambridge 14-17 Aug. 1955, Mitchell, J. S., Holmes, B. E., Smith, C. L., eds. London, Oliver and Boyd. 1956)

1460 Wallace, B. THE AVERAGE EFFECT OF RADIATION-INDUCED MUTATIONS ON VIABILITY IN DROSOPHILA MELANOGASTER. Evolution 12 (1958) 532-56.

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

1461 Wallace, B. THE ROLE OF HETEROZYGOSITY IN DROSOPHILA POPULATIONS. AECU-3851, Long Island Biological Assn., Biological Lab., Cold Spring Harbor, N. Y. 1958, 18 p.

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 3¼ million flies are summarized in tabular form. Limitations of the experimental procedures and results of the experiments are discussed. (NSA 13: 508, 1959)

1462 Wallace, B. THE INVESTIGATION OF THE GENETIC STRUCTURE OF POPULATIONS. TID-11062, New York State Coll. of Agriculture, Ithaca, 1960, 30 p.

The report discusses the results of three new experiments on the viability effects of newly induced mutations. Two of these 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.

1463 Wallace, B., King, J. C. RADIATIONS AND POPULATIONS. Cold Spring Harbor Biol. Lab. Ann. Rep. 61 (1950) 29-33.

Irradiated populations of Drosophila melanogaster were analysed 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 natural populations is stressed.

1464 Wallace, B., King, J. C. GENETIC CHANGES IN POPULATIONS UNDER IRRADIATION. Amer. Naturalist 85, 823 (1951) 209-22.

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 viabilities of random heterozygotes. The discussion deals with the establishment within populations of coordinated genetic systems and the bearing this process has on irradiated populations generally. (BA 25: 35617, 1951)

(Also published as AECU-1442, Long Island Biological Assn., Biological Lab., Cold Spring Harbor, N. Y. 19 p)

1465 Wasserman, M. STUDIES IN THE GENETICS OF DROSOPHILA. VIII. ARTICLES ON GENETICS, TAXONOMY, CYTOLOGY AND RADIATION. XII. POPULATION STUDIES WITH DROSOPHILA MULLERI. Univ. Tex. Publ. No. 5422 (1954) 166-88.

The fate of x-ray induced chromosomal abnormalities introduced into a small, semi-isolated population of Drosophila mulleri was investigated. By the sampling technique used no 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 auth. summary)

II APPLICATIONS

II - A Sterile Male Technique

II-A-1 SCREWWORM FLY

1466 Baumhover, A. H., Graham, A. J., Bitter, B. A., Hopkins, D. E., New, W. D., Dudley, F. H., Bushland, R. C. SCREW-WORM CONTROL THROUGH RELEASE OF STERILIZED FLIES. J. econ. Ent. 48, 4 (1955) 462-6.

Experiments were carried out on the island of Curaçao to test whether an isolated population of Callitroga hominivorax (Cqrl.) could be eradicated through the release of sterilized flies. 5-d-old pupae were sterilized with γ-radiation and sent to Curaçao by air freight. Adults emerged after 2 d irradiation and were released within 24 h. Sterilized flies were released (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. Releases 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 J. Amer. vet. med. Ass. 126 (1955) 229 briefly reporting the Curaçao experiments (see index for detailed articles).

1467 Baumhover, A. H., Skipper, C. C., New, W. D. FIELD OBSERVATIONS ON THE EFFECTS OF RELEASING STERILE SCREW-WORMS IN A 2000 SQUARE MILE AREA IN FLORIDA. Bull. ent. Soc. Amer. 3, 3 (1957) 35, abstr. 20.

From May 1, 1957 through August 16, 1957 approximately 2 000 000 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 screwworm population as determined by egg mass collections and case incidence.

1468 Baumhover, A. H. FLORIDA SCREWWORM CONTROL PROGRAM. Vet. Med. 53 (1958) 216-9.

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.

1469 Baumhover, A. H., Husman, C. N., Skipper, C. C., New, W. D. FIELD OBSERVATIONS ON THE EFFECTS OF RELEASING STERILE SCREW-WORMS IN FLORIDA. J. econ. Ent. 52 (1959) 1202-6.

Approximately 500 sterile male screwworm flies (Callitroga hominivorax (Cqrl.)) were released weekly per square mile over a 2000-square-mile area in Florida. The insects had been irradiated as pupae, within 2 d of adult emergence, within 6200 to 8300 r gamma rays from Co^{60}. They were packaged at the rate of 880 (later 550) pupae per release carton. Flies were distributed daily in 6-mile swaths by small aircraft. Shifting of flight lanes 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 2 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 dispersal of sterilized screwworm flies from aircraft" in Bull. ent. Soc. Amer. 3, 3 (1957) 35, abstr. 19)

* Borstel 1960 - [1436]

1470 Bull, J. O. INSECT ERADICATION BY STERILE MALE RELEASE. p. 117-29 in "The Technological Use of Radiation. Proceedings of the Conference on the Technological Use of Radiation, Sydney, Australia 23-25 May 1960". Sydney, Australian Atomic Energy Commission. 1961.

Eradication of insects by release of sterile males exploits the mating behaviour of the male to find and inseminate the female with sterile sperms. Operation of the method and factors essential for success are reviewed in relation to the eradication of screw-worm fly (Callitroga hominivorax) 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 1953 - [1111]

1471 Bushland, R. C., Lindquist, A. W., Knipling, E. F. ERADICATION OF SCREW-WORMS THROUGH RELEASE OF STERILIZED MALES. Science 122 (1955) 287-8.

An experiment was conducted on the island of Curaçao, which is beyond the flight range of screwworms (Callitroga hominivorax (Cqrl.)). Sterilized flies were released from the air at the rate of 100 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.

1472 Bushland, R. C., Knipling, E. F., Lindquist, A. W. ERADICATION OF THE SCREW-WORM FLY BY RELEASING GAMMA-RAY-STERILIZED MALES AMONG THE NATURAL POPULATION. UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 8/P/114. 12 (1956) 216-20.

An account is given of the background work which led to the eradication of the screwworm fly, Callitroga hominivorax (Cqrl.), 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.

1473 Bushland, R. C. USE OF RADIATION IN INSECT CONTROL. p. 711-5 in "Proceedings of the 10th International Congress on Entomology, Montreal 17-25 Aug. 1956", Vol. 3. Becker, E. C., ed. Ottawa, Mortimer Ltd. 1958.

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 operation as 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 males of a natural population is a form of biological control now being tried on screwworms (Callitroga hominivorax (Cqrl.)). 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 meantime 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 seems not to have the promise of lethal or sterilizing radiations. (auth.)

1474 Bushland, R. C. INSECT ERADICATION BY MEANS OF STERILIZED MALES. Plants and Gns 16 (1960) 88-94.

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

1475 Bushland, R. C. INSECT ERADICATION BY RELEASE OF STERILIZED MALES. p. 273-89 in "Large Radiation Sources in Industry", Conference Proceedings, Warsaw, 8-12 Sep. 1959". Vienna, International Atomic Energy Agency, 1960.

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

1476 Bushland, R. C. MALE STERILIZATION FOR THE CONTROL OF INSECTS. p. 1-25 in "Advances in Pest Control Research", Vol. 3, Metcalf, R. L., ed. New York, Interscience Publishers, Inc. 1960.

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 on Curaçao. The use of sterilized males for the control of other insects is discussed (fruit fly, mosquito, codling 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 age mating occurs in various species, and how frequently each sex copulates but also details of spermatogenesis and oögenesis as they relate to establishing the time for a sterilizing dose of γ-rays.

1477 Bushland, R. C. SCREW-WORM RESEARCH AND ERADICATION. Advanc. Vet. Sci. 6 (1960) 1-18.

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 also the genetic basis for irradiation sterilization. After some field work in Florida the eradication campaign in Curaçao was started and completed successfully. Techniques for mass rearing, sterilizing and distributing the flies are described. Insecticides for screwworm control are also applied (dressings, sprays and dusts). Screwworm eradication programmes in the southeast of the USA are discussed.

1478 Graham, A. J., Dudley, F. H. CULTURE METHODS FOR MASS REARING OF SCREW-WORM LARVAE. J. econ. Ent. 52 (1959) 1006-8.

Screwworm (Callitroga hominivorax (Cqrl.)) larvae were reared in sufficient numbers to produce 2 million sterilized flies weekly for 15 consecutive weeks in a Florida field test. Five days each week eggs were obtained from 20 colony cages, each stocked with 700 8-d-old flies, by heating 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 80°F and 90+ per cent relative humidity. (auth.)

(Presented earlier, see Bull. ent. Soc. Amer. 3, 3 (1957) 35, abstr. 18)

1479 Jefferson, M. E. IRRADIATED MALES ELIMINATE SCREWWORM FLIES. Nucleonics 18, 2 (1960) 75-7.

Details of the irradiator (γ from Co^{60}), 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.

1480 Knipling, E. F. POSSIBILITIES OF INSECT CONTROL OR ERADICATION THROUGH THE USE OF SEXUALLY STERILE MALES. J. econ. Ent. 48, 4 (1955) 459-62.

A number of key factors must be considered and resolved before the procedure can be regarded as feasible for eradicating or controlling any given pest. 1. A method of mass rearing 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 measures is stressed. (from auth. summary)

1481 Knipling, E. F. CONTROL OF SCREW-WORM FLY BY ATOMIC RADIATION. Sci. Mon., Lond. 85 (1957) 195-202.

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 in insects.

(See also TID-3078(143), Technical Information Service, AEC. 1960, 35 p)

1482 Knipling, E. F. SCREWWORM ERADICATION: CONCEPTS AND RESEARCH LEADING TO THE STERILE-MALE METHOD. Smithson. Inst., Ann. Rep. 1958 (1959) 409-18.

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

1483 Knipling, E. F. STERILE-MALE METHOD OF POPULATION CONTROL. SUCCESSFUL WITH SOME INSECTS, THE METHOD MAY ALSO BE EFFECTIVE WHEN APPLIED TO OTHER NOXIOUS ANIMALS. Science 130, 3380 (1959) 902-4.

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 Callitroga hominivorax (achieved by the 4th generation) are pointed out. Theoretical population trends are considered in tabulated form and the efficacy of the sterile-male technique discussed for the various cases. The advantages 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.

1484 Knipling, E. F. CONTROL OF SCREWWORM FLY BY ATOMIC RADIATION. p. 169-82 in "Biological and Chemical Control of Pests. Symposium". Washington, D.C., American Association for the Advancement of Science, Section O, Agriculture. 1960.

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

* Knipling 1960 - [1444]

1485 Knipling, E. F. THE ERADICATION OF THE SCREW-WORM FLY. Sci. Amer. 203, 4 (1960) 54-61.

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 preceded 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. Sustained release over the infested 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 matings 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.

1486 Knipling, E. F. USE OF INSECTS FOR THEIR OWN DESTRUCTION. J. econ. Ent. 53 (1960) 415-20.

Review article. In considering ways of controlling or eradicating insect populations, 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 noneconomic 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 progeny 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. (auth.)

1487 Lindquist, A. W. SCREW-WORM CONTROL THROUGH RELEASE OF STERILIZED FLIES. J. econ. Ent. 48, 4 (1955) 467-9.

The screwworm, Callitroga hominivorax (Cqrl.), has a comparatively low natural population. Research conducted by the Entomology Research Branch showed that sterilized males released over small areas mated with native females, and that the eggs produced were infertile. The release of sterilized males on the

island of Curaçao at the rate of approximately 400 per square mile per week for 7 weeks caused an initial sterility of about 70% which increased to 100% sterility as the number of flies and egg masses declined. Releases were continued for 3 more months, during which time no eggs, flies, or screwworm cases could be found. Apparently eradication was achieved during a time of year when the infestation normally increases. The possibility of using this method of eradication in Florida is considered as promising by the authors. Eradication in Texas does not appear practical because the screwworm is present in Mexico. Temporary control might be achieved in overwintering areas of Texas, but the practicability of such an effort is dependent on costs of rearing and releasing screwworms.

1488 Lindquist, A. W. USE OF SEXUALLY STERILE MALES FOR ERADICATION OF SCREW WORMS. p. 229-35 in "Radioisotopes and Radiation in the Life Sciences. 2nd Inter-American Symposium on the Peaceful Application of Nuclear Energy, Buenos Aires 1959". TID-7554. Washington, D. C., Pan American Union. 1960.

Exploratory experimental work on Callitroga hominivorax control is reviewed. Its life history and its importance as a parasite of warm-blooded animals are discussed, the destructiveness of the screwworm 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 screwworm females mate only once a reduction in population is soon evident. Results are reported for an immense eradication program covering about 50 000 square miles in Florida.

1489 Smith, C. L. MASS PRODUCTION OF SCREW-WORMS (CALLITROGA HOMINIVORAX) FOR THE ERADICATION PROGRAM IN THE SOUTHEASTERN STATES. J. econ. Ent. 53 (1960) 1110-6.

From January 1958 to October 1959 slightly more than 3.75×10^9 pupae were produced, utilizing approximately 6⅛ million pounds of horse and whale meat, during the screwworm eradication programme conducted in the Southeastern States, by the procedures described. The number of grams of eggs obtained from the stock colony and the grams required to meet the weekly fly production quota; the amount of horse and whale meat utilized in producing the minimum of 50 million flies weekly required for field releases; and the number of pupae produced in relation to the number of flies released are shown graphically. (auth.)

II-A-2 FRUIT FLIES

1490 Christenson, L. D. RECENT PROGRESS IN THE DEVELOPMENT OF PROCEDURES FOR ERADICATING OR CONTROLLING TROPICAL FRUIT FLIES. p. 11-6 in "Proceedings of the 10th International Congress on Entomology, Montreal 17-25 Aug. 1956", Vol. 3 Becker, E. C. ed. Ottawa, Mortimer Ltd. 1958.

The possible application of the sterile male release method is also discussed for application to fruit fly problems.

1491 Christenson, L. D., Steiner, L. F., Balock, J. W., Stone, W. E. APPLICATION OF STERILE FLY RELEASE AND OTHER RADIATION TECHNIQUES TO TROPICAL FRUIT FLY CONTROL, ERADICATION AND QUARANTINE PROBLEMS. Bull. ent. Soc. Amer. 5, 3 (1959) 116, abstr. 62.

Overflooding 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 quarantine usefulness for an irradiation treatment applied to fresh fruits and vegetables.

1492 Monro, J. 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 23-25 May 1960". Sydney, Australian Atomic Energy Commission, 1961.

The Queensland fruit-fly, Dacus 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, presumably 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 ages on subsequent mating

behaviour and male longevity are discussed. Mating 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. tryoni is suited to this method but much research still remains to be done, particularly on the ecology. (Discussion: p. 135-7.)

1493 Steiner, L. F., Christenson, L. D. POTENTIAL USEFULNESS OF THE STERILE FLY RELEASE METHOD IN FRUIT FLY ERADICATION PROGRAMS. (abstr.) Proc. Hawaii. Acad. Sci. (31st Annu. Mtg 1955/6) (1956) 17-8.

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 (Dacus cucurbitae 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 γ-irradiation on fruit flies has not been determined. In addition to the presumed production of a high percentage of dominant lethals in the motile spermatozoa, there appeared to be some reduction in the motile sperm-producing capacity. Despite the unfavourable 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 1957 - [1152]

* Potts 1957/58 - [874]

1494 Potts, W. H. STERILIZATION OF TSETSE FLIES (GLOSSINA) BY GAMMA RADIATION. Ann. trop. Med. Parasit. 52, 4 (1958) 484-99.

Pupae of Glossina palpalis collected in the field in East Africa were sent to London where they were subjected to gamma irradiation from a Co^{60} source. Dosage varied between 3×10^3 and 3×10^4 rep. Dissection of samples of pupae at the time of irradiation indicated that of those viable (2/3), 80% were in the middle stages of development (5th - 22nd d of a 27-d pupal period) and 20% were in late stages of development (23 - 27th d of pupal period). Fertility of females was determined by dissection. As the testes appeared completely normal after irradiation, fertility of males was gauged by mating with normal females. Pupal mortality was not increased by doses of irradiation of up to 12×10^3 rep but there was a decreased emergence at 3×10^4 rep. The life span of male flies was halved but mating ability was not affected. At 6×10^3 rep 10 - 20% of males were not sterilized, and at 3×10^3 and 12×10^3 rep 10 - 16% of females remained fertile. (BA 33: 47223, 1959)

1495 Ray, J. WILL ATOMIC RADIATION CONTROL AFRICA'S TSETSE FLY? Foreign Agric. (USA) 20, 6 (1957) 15 - 6.

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

1496 Simpson, H. R. THE EFFECT OF STERILISED MALES ON A NATURAL TSETSE FLY POPULATION. Biometrics 14 (1958) 159-73.

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 insecticidal application immediately before the release of sterilized males. Experimental data show that both sexes are sterilized by γ-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 Baccetti, B. NUCLEAR ENERGY FOR CONTROL OF INSECT PESTS. Ital. Agric. 95, 11 (1958) 713-7. (In Italian)

Review article.

1498 Knipling, E. F. PROGRESS AND PROBLEMS FOR THE FUTURE OF MEDICAL AND VETERINARY ENTOMOLOGY. p. 689-95 in "Proceedings of the 10th International Congress on Entomology, Montreal 17-25 Aug. 1956", Vol. 3, Becker, E. C. ed. Ottawa, Mortimer Ltd. 1958.

Review article of wide general interest.

1499 Singleton, W. R., ed. NUCLEAR RADIATION IN FOOD AND AGRICULTURE. Princeton, N. J., D. Van Nostrand Co., Inc. 1958, 387 p.

The chapters in this book are based on papers selected from those presented at the UN Conference on Peaceful Uses of Atomic Energy held in Geneva, Switzerland, in Aug. 1955. Selection was exercized not only in the individual papers chosen but also in the topics. Topics covered include the general use of radioisotopes in agriculture (p. 1-26 describe Canadian work, cf. Spinks, 12: 75); genetic and biological hazards of nuclear radiation; the genetic eradication of insect pests (p. 281-90, cf. Bushland et al., 12: 216); and applications of radiation in food sterilization and preservation.

* Crook et al. 1960 - [1114]

* Davis et al. 1959 - [1116]

1500 MacLeod, J. ATOMIC WAR AGAINST AN INSECT; BRITISH TRIALS OF A NEW INSECT CONTROL TECHNIQUE USING GAMMA RAYS TO STERILISE MALE FLIES. Chemist and Druggist 172, 4151 (1955) 4-6.

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 vitality of the adult fly. In 1956-57 a field test was made 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 as being 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.

* Vasilyan 1960 - [1124]

II - B Stored Products Infestation and its Detection

II-B-1 COMMODITIES

Survey articles

* Baker et al. 1954 - [1241]

1501 Cornwell, P. B. THE CONTROL OF PESTS IN GRAIN BY GAMMA IRRADIATION. New Scientist 4, 79 (1958) 30-33.

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.

1502 Deschreider, A.R. LA MEUNERIE ET L'ENERGIE ATOMIQUE. Bull. Ec. off. Meun. belge, Gand 19, 6 (1957) 86-98.

Review article dealing with the effects of radiation on plants, insects, and, in particular, on wheat and flour. Practical implications are discussed.

1503 Deschreider, A.R. LA MEUNERIE ET L'ENERGIE ATOMIQUE. Bull. Ec. off. Meun. belge, Gand 20, 2 (1958) 16-30.

Practical applications are discussed.

* Hassett and Jenkins 1952 - [1252]

1504 Hassett, C.C. CURRENT STATUS OF INSECT CONTROL BY RADIATION. Science 124 (1956) 1011-2.

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 insect pests. New sources of radiation from particle accelerators and radioisotopes are described, and estimates of capacity and cost given for facilities designed to treat stored products.

* Hassett 1957 - [1253]

1505 Kuprianoff, J. DIE MÖGLICHKEITEN DER ANWENDUNG IONISIERENDER STRAHLEN BEI GETREIDE UND GETREIDEPRODUKTEN (Scope of applying ionizing radiation to grain and grain products). Getreide 6 (1956) 81-5. (In German)

Review. Various aspects of grain preservation, the application of radiation and its effects on conservation and quality are discussed generally.

1506 Risø Research Establishment, Risø, Denmark. LEVNEDSMIDDELKONSERVERING VED BESTRALING. ORIENTERENDE MØDE PA RISØ DEN 25. FEBRUARY 1959 (Food Preservation by Radiation. Orientation Meeting at Risø, February 25, 1959). NP-7709, Denmark, Atomenergikommissionen. Forsøgsinstitut, Risø. 1959, 91p. (In Danish)

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 Risø.

xxxxyxxx

* Baker et al. 1953 - [1240]

* Baker et al. 1954 - [1243]

* Balock et al. 1956 - [1171]

1507 Bletchly, J.D. STUDYING THE EGGS OF LYCTUS BRUNNEUS. Timber Technol. 68 (1960) 30-1.

In the course of studies on the possible use of γ-radiation in the control of wood-boring insects it was necessary to cut up a considerable number of Lyctus egg-laying blocks (Bletchly, 1956). 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. Veneers cut at 150μ and 200μ proved to be the most suitable thickness. In general, blocks containing 3 or more veneers proved the most suitable.

* Brownell et al. 1954 - [1528]

* Brownell et al. 1956 - [1530]

* Brownell et al. 1957 - [1531]

1508 Brownell, L. E., Nehemias, J. V. GAMMA IRRADIATION OF WHEAT AND WHEAT PRODUCTS FOR INSECT CONTROL. Amer. Miller & Processor 85, 2 (1957) 19-20, 26, 28, 32.

* Cornwell et al. 1957 - [1113]

1509 Cornwell, P. B. EFFECTS OF γ-RADIATION ON THE TASTE AND MANUFACTURING PROPERTIES OF SOFT WHEAT. J. Sci. Food Agric. 10 (1959) 409-12.

A preliminary study was made of the effects of 3 dose levels of γ-radiation on the physical, biochemical and baking properties of English wheat. Products made from irradiated grain have been examined for organoleptic changes by a taste panel of selected members. The slight changes induced by irradiation are considered of little commercial significance. Disinfestation of grain by γ-irradiation could thus be applied without adversely affecting the baking quality of the milled product.

1510 Cornwell, P. B. THE DISINFESTATION OF FOODS, PARTICULARLY GRAIN. Intern. J. Appl. Radiation and Isotopes 6 (1959) 188-93.

There are two potential methods of controlling insect pests by irradiation; indirect control by the release of sterilized adults and the direct treatment of infested products. Application of the first method is limited to certain species by a number of biological and environmental factors. The second method could have wider application for the control of all species infesting stored materials. Among the factors which may influence its success, problems associated with bulk handling and the incorporation of treatment into established handling procedures must receive primary consideration. These could be most easily solved in the treatment of packaged goods where production and irradiation may be carefully integrated. (auth.)

1511 Cornwell, P. B., Bull, J. O. INSECT CONTROL BY GAMMA-IRRADIATION: AN APPRAISAL OF THE POTENTIALITIES AND PROBLEMS INVOLVED. J. Sci. Food Agric. 11, 12 (1960) 754-68.

Review article. Lethal and sterilizing effects have been examined on different species, strains and developmental stages to evaluate dose levels required for commercial treatment. Research results and problems of application are examined in relation to the two potential methods of controlling insect pests by irradiation: indirectly, by the release of sterilized adults, and by the direct treatment of infested products. The first can only be applied to very few species due to certain biological requirements involved. Products handled in bulk at particular centres are the ones most favourable for disinfestation by radiation. Treatment of grain has been examined in detail. The fundamental and applied problems of using γ-radiation are discussed, and the relative merits of fumigation and radiation sterilization compared. Among factors which may influence the success of radiation disinfestation, bulk handling and the incorporation of treatment into established handling procedures must receive primary consideration. γ-irradiation may eventually take its place as a useful means of insect control, but it is unlikely to displace conventional methods.

1512 Cornwell, P. B. INSECT CONTROL BY IONIZING RADIATIONS. - AN APPRAISAL OF THE POTENTIALITIES AND PROBLEMS INVOLVED. p. 104-16 in "The Technological Use of Radiation. Proceedings of the Conference on the Technological Use of Radiation, Sydney, Australia 23-25 May 1960". Sydney, Australian Atomic Energy Commission. 1961.

Following an introductory survey, the results of research and problems of application are examined in relation to the practical feasibility of applying radiation disinfestation to stored products commodities. The most favourable products for radiation disinfestation are those handled in bulk at particular centres, and therefore radiation treatment of grain has been examined in detail. The fundamental and applied problems of using ionizing radiation for sterilization are compared. It is concluded that among factors which may influence the success of radiation disinfestation, bulk handling and the incorporation of treatment into established handling procedures must receive primary consideration. Ionizing radiations may eventually take their place as a useful means of insect control but their adoption is unlikely to displace conventional methods. (from auth. summary)

* Crean et al. 1953 - [1533]

1513 Hall, R. L. THE EFFECT OF IONIZING RADIATION ON SPICES. AD-228151, Report No. 8 (Final) for 26 Sep. 1955 - 25 Sep. 1958. Technical Information Serv., Baltimore, McCormick and Co. 13 p.

Insect infestation can be eliminated in spice products by ionizing radiations. In practically every case, the irradiated spices examined showed no evidence of live insects after 3 months incubation; this was at levels

of 50 000 and 75 000 rep. When irradiated with 3×10^6 rep, no significant change in the character of the spice itself occurred, as measured by triangle comparisons using a panel of about 20 members. None of the spices investigated, when combined in frankfurters and pork sausage and irradiated at $0.75 - 3.0 \times 10^6$ rep, showed any tendency to significantly mask or prevent ionized flavour and odour. In general, irradiation appears to reduce the odour and flavour of spices in pork sausage. (auth.)

(See also Progress Reports Nos. 1 - 7, US Army Quartermaster Corps Con. No. QMR & D No. 28, (Natick) 1 Feb. - 30 Apr. 1956)

* Jefferies and Cornwell 1958 - [1144]

1514 Kuprianoff, J. ZUSAMMENFASSENDE ÜBERSICHTSBERICHTE. LEBENSMITTELKONSERVIERUNG DURCH IONISIERENDE β- UND γ-STRAHLEN (Comprehensive reviews. Food preservation by ionizing β- and γ-rays). Z. LebensmittUntersuch. 100 (1955) 275-303. (In German)

The subject is reviewed under the subtitles: (A) electron rays: irradiation effect, irradiation energy, irradiation dosage, irradiation time; irradiation sensitivity of micro-organisms, virus, enzymes, insects and food; influence of the size of the object, composition, temperature, atmosphere and packaging, apparent construction, tests with individual foods (meat, butter, eggs, milk, fruit and vegetables), usefulness of the process; (B) electromagnetic rays: ultraviolet light, x-rays, γ-rays, ray sources, irradiation effects, irradiation of foods (list same as in above parentheses), toxic products, usefulness; outlook for the processes. (CA 49: 8513g, 1955)

1515 Nicholas, R. C., Wiant, D. E. RADIATION OF IMPORTANT GRAIN-INFESTING PESTS: ORDER OF DEATH CURVES, AND SURVIVAL VALUES FOR THE VARIOUS METAMORPHIC FORMS. Food Technol 13 (1959) 58 - 62.

Twelve grain-infesting pests were treated with 1-MeV electrons at various doses to determine the lethal effect of the treatment on the metamorphic forms and to determine sterility effects on the adults. Order of death curves of survivors against time at near-100%-lethal doses, where obtained, verify the sigmoid shape of the curves at sub-100%-lethal doses. Plots of survivors against dose on log-normal coordinates represent the data. In general, graded resistance is exhibited within a species increasing with insect age from egg to adult. Of the insect species, the moths showed higher resistance to radiation than the beetles. Pests covered by the study were the Mediterranean flour moth (Ephestia kühniella Zell); the saw-toothed grain beetle (Oryzaephilus surinamensis (L.)); the Indian meal moth (Plodia interpunetella (Hbn.)); the lesser grain-borer (Rhyzopertha dominica (F.)); the granary weevil (Sitophilus granarius (L.)); the rice weevil (Sitophilus oryza (L.)); the Angoumois grain moth (Sitotroga cerealella Oliv.); the yellow meal worm (Tenebrio molitor (L.)); the cadelle beetle (Tenebriodes mauritanicus (L.)); the confused flour beetle (Tribolium confusum Duv.); book lice (Psocoptera); and the flour mite (Acarus siro (L.)(?)).

1516 Nickerson, J. T. R. EXTENSION OF STORAGE LIFE OF FOODS USING IONIZING ENERGY. p. 116-23 in "Proceedings of the International Conference on the Preservation of Foods by Ionizing Radiations 27 - 30 July 1959", Cambridge, Mass., Massachussetts Institute of Technology, 1959, 290 p.

A review article, divided into various sections dealing with the low-dose-level treatment of foods with ionizing radiations for different purposes. One section deals with results obtained with different dose levels and sources on insects and their eggs in grain, flour and meal. Running costs of exploiting cooling reactor fuel elements as gamma sources are estimated.

* Park et al. 1958 - [1151]

1517 Передельский, А.А., Родионова, Л.З., Бибергаль, А.В., Румянцев, П.Д., Перцовский, Е.С. РАЗРАБОТКА МЕТОДА БОРЬБЫ С НАСЕКОМЫМИ - ВРЕДИТЕЛЯМИ ХРАНЯЩЕГОСЯ ЗЕРНА ПРИ ПОМОЩИ ИОНИЗИРУЮЩИХ ИЗЛУЧЕНИЙ. Труды Всес. н.-и. ин-та зерна и продуктов его переработки, Москва 35 (1958) 28-42.

Против амбарного и рисового долгоносиков зерно облучали рентгеновыми аппаратами РУМ-3 (200 кв, фильтр 0,5 мм Cu) и РУП-3 (400 кв, фильтр 2 мм Cu + 0,25 мм Fe). Для обеззараживания зерна необходима доза 10 000 р, как и других излучений - потока быстрых электронов, γ-лучей. Для промышленной дезинсекции пригодными источниками излучений являются генераторы быстрых электронов и мощные изотопные источники γ-излучений.

Наиболее перспективные источники γ-излучений – осколки деления ядер урана (стоимость этих отходов атомной промышленности низка). Во ВНИИЗ проектируется полупроизводственная γ-установка для дезинсекции зерна в потоке.

Peredelsky, A. A., Rodionova, L. Z., Bibergal, A. V., Rumyantsev, P. D., Pertsovsky, E. S., DEVELOPMENT OF A METHOD FOR CONTROLLING INSECT PESTS OF STORED GRAIN BY MEANS OF IONIZING RADIATION. Trudy vses. n.-i. in-ta zerna i produktov ego pererabotki (Trans. All-Un. sci. Res. Inst. of Grains and Products of Processed Grain) 35 (1958) 28-42.

In order to control Sitophilus granarius and S. oryza, the grain was irradiated, using x-ray installations RUM-3 (200 kV, 0.5 mm Cu filter) and RUP-3 (400 kV, 2.0 mm Cu plus 0.25 mm Fe filter). 10 000 r were required, whether x-rays, fast electrons or γ-rays were used. For deinfestation, fast electron generators and powerful isotope sources of γ-radiation represent suitable sources. Fission fragments of uranium nuclei represent the most promising sources of γ-rays in view of the low cost of these waste materials from atomic industry. A pilot γ-installation is being designed at the Institute which should allow the deinfestation of grain on production lines. (from Referativny Zhurnal Biologia 1: 7082, 1959)

1518 Peredelsky, A. A., Rumyantsev, P. D., Rodionova, L. Z., Bibergal, A. V., Pertsovsky, E. S. IONIZING RADIATIONS AS MEANS OF COMBATING INSECT PESTS. p. 217-9 in English translation of orig. Russian "Application of Radioactive Isotopes in the Food and Fishing Industries and in Agriculture. A portion of the Proceedings of the All-Union Scientific and Technical Conference on the Application of Radioactive Isotopes, Moscow 1957", New York, Consultants Bureau, Inc., 1959.

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 destruction of pest populations, to use only comparatively small doses (10 000 r) of x- or γ-rays, which produce general infertility or fatal damage in the embryonic or post-embryonic development of the progeny of the irradiated parents. The extinction of weevils in all stages of development is, furthermore, accelerated, following 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 stock pests. To facilitate dosage calculation, blue prints of a powerful γ-radiation installation suitable for pilot-plant testing of irradiation of consumer grain supplies are being drawn up. Radioactive isotopes of cobalt and cesium, and mixtures of nuclear reactor wastes are proposed as sources of radiations.

(See also "Use of ionizing radiation against pests of stored grain." Biophysics 2: 209-213, 1957)

(For detailed abstract see "Ionizing radiations as a means of controlling insect pests in grain stocks" p. 134-5 in Abstracts of papers given at the "All-Union Conference on the Application of Radioactive and Stable Isotopes and Radiation in the National Economy and Science. Session: Biology, Medicine and Agriculture. Moscow 2-5 Apr. 1957". AEC-tr-2925 (III). New York, Consultants Bureau, Inc. 1957)

1519 Pomerantz, R., Mastran, J. L. THE UNITED STATES ARMY IONIZING RADIATION CENTER. 2nd UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 15/P/739, 27 (1958) 406-9.

Plans for the layout and tasks of the USAIRC 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 USAIRC, and are given under fruits and vegetables, meats and poultry, and cereal and baked products. Operation will encompass the comparison of γ-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-infestation and the inhibition of sprouting in potatoes and other tubers. The linear-accelerator-conveyor complex will consist of a 24-MeV, 18 kW accelerator and its ancillary conveyor equipment, and will be the most powerful unit ever to be constructed for radiation processing.

1520 Porretta, A. L'IMPIEGO DELLE RADIAZIONI IONIZZANTI PER LA CONSERVAZIONE DEGLI ALIMENTI (The use of ionizing radiation for the preservation of food – the present state of knowledge and future prospects). CNB-19, Comi. naz. Richerche Nucleari, Milan, Notiziario. 1960, 148 p. (In Italian)

A review article. The author examines the problems connected with the use of ionizing radiation for the sterilization, pasteurization and disinfestation of foods. A total of 224 references is listed.

1521 Proctor, B. E., Goldblith, S. A. FOOD PROCESSING WITH IONIZING RADIATIONS. Food Technol. 5 (1951) 376-80.

The type of radiation necessary to sterilize foods and drugs, the specific inactivation doses of radiations, the effects of irradiation on flavour, colour, texture and nutrients and packaging problems are discussed. Results on work with cereals infested with Sitophilus granarius and Tribolium confusum are given. The adaptation of radiation processes to existing production lines are discussed and illustrated.

1522 Proctor, B. E., Lockhart, E., Goldblith, A. S., Grundy, A. V., Tripp, G. E., Karel, M., Broglé, R. C. THE USE OF IONIZING RADIATIONS IN THE ERADICATION OF INSECTS IN PACKAGED MILITARY RATIONS. Food Technol. 8, 12 (1954) 536-40.

The use of ionizing radiations for the control of insect infestation in certain packaged military ration components was investigated, and determinations were made of the doses of high-energy cathode rays, x-rays and γ-rays needed to destroy all metamorphic forms of different insect species. Organoleptic tests 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 auth.)

1523 Richardson, H. H., Balock, J. W. TREATMENTS TO PERMIT MOVEMENT OF AGRICULTURAL PRODUCTS UNDER PLANT QUARANTINE. Agr. Chemic. 14 (1959) 43-6, 119.

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 dosages which effectively inhibit fruit fly reproduction. Work on mango, cucumber, cantaloupe, peach, squash and tomato is mentioned.

1524 Shiroisi, M., Hayakawa, A., Watanabe, Y., Fukamachi, C., Sakurai, Y. PRESERVATION OF FOOD BY IONIZING RADIATION (PRELIMINARY REPORT); EFFECTS OF GAMMA-RAYS ON TRIBOLIUM CONFUSUM, GERMINATION OF WHEAT AND VITAMIN B_1 CONTENT OF WHEAT FLOUR. Tokyo Food Res. Inst. Rpt. 1956, 11, 57-62. (In Japanese)

1525 Trump, J. G., Proctor, B. E. STERILIZING WITH ELECTRONS. Modern Packaging 24 (1951) 105-6, 164.

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 infected by Sitophilus granarius and Tribolium confusum.

II-B-2 SOURCES FOR DISINFESTATION

1526 Anonymous. FIRST DESIGNS FOR COMMERCIAL GRAIN IRRADIATED EQUIPMENT REVEALED. Modern Sanit. 7, 5 (1955) 49.

* Baker et al. 1954 - [1241]

1527 Bibergal, A. V., Margulis, U. Y., Pertsovsky, E. S. THE USE OF POWERFUL RADIATION SOURCES FOR THE DISINFECTION OF GRAIN. Atomnaya Energia 2, 4 (1957) 376. (In Russian)

A design for an experimental pilot plant for the disinfestation of grain by means of Co^{60} γ-irradiation is described. The source consists of a shallow cylinder with 20 rods, totalling an activity of 100 000 g. eq. Ra, spaced along its sides. The plant is provided with protective water shielding. The grain is fed in automatically for irradiation. Co^{60} has been found to be uneconomical for large-scale grain disinfestation plants because of its prohibitive cost. It is much more profitable to use the uranium fission products available as atomic industry wastes. Due to the low specific activity of the fission products the selection of the most rational geometry of the irradiator requires special care. Cell irradiators 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

irradiator is 31 tons/h at a net activity of 3.72×10^6 c. The relatively low weight of the installation (including water shielding) makes its transportation from one granary to another an easy matter.

1528 Brownell, L. E., Anderson, L. C., Gomberg, H. J., Kempe, L. L., Martin, J. J., Nehemias, J. V., Wolfe, R. A. UTILIZATION OF THE GROSS FISSION PRODUCTS. PROGRESS REPORT NO. 7. AECU-2981, Engng Res. Inst., Univ. of Michigan, 1954, 249 p.

The use of gross fission products in the preservation of various food stuffs, and the results of tests are described. A γ-dose of 25 000 rep was sufficient to disinfest flour and wheat from insects and this amount of irradiation had no undesirable effects on taste and baking qualities.

1529 Brownell, L. E., Nehemias, J. V., Bulmer, J. J. OPERATION OF THE FISSION PRODUCTS LABORATORY. QUARTERLY PROGRESS REPORT NO. 1 FOR THE PERIOD JAN. 1, 1955 TO MARCH 30, 1955. AECU-3028, Michigan, Univ., Ann Arbor, Engng Res. Inst. 1955, 27 p.

The design of a mashbox to be used for feeding irradiated wet mash 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 infestation of flour, the effect of γ-radiation on the baking quality of wheat flours, 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. (NSA 9: 6507, 1955)

1530 Brownell, L. E., Nehemias, J. V., Bulmer, J. J. PLAN EINER GAMMABESTRAHLUNGSANLAGE ZUR VERHINDERUNG DES INSEKTENBEFALLS VON GETREIDE, MEHL UND FUTTERMITTELN (The design of a gamma irradiation plant for the prevention of infestation by insects of grain, flour and food stuffs). Atompraxis 2 (1956) 225-33. (In German)

After a discussion of the type of insect infestation occurring in cereals, of the known effects of ionizing radiations on insects, and of γ-rays on the baking quality of wheat, the authors describe one kind of γ-radiation plant. Activated fuel elements are used as a source. Doses, capacity and economical considerations are discussed. A routine dose of 25 000 rep is considered, which provides an adequate safety factor since only 10^4 rep 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 10 years, the cost of flour irradiation amounts to approximately $0.0373 per sack of 100 lb.

(For an earlier report, in English, see AECU-3050, 23 p, 1955, Univ. Michigan, Ann Arbor, Mich.)

1531 Brownell, L. E., Nehemias, J. V., Purohit, S. N. GAMMA-IRRADIATION FACILITIES DESIGNED TO PROCESS COMMERCIAL QUANTITIES OF FOOD PRODUCTS. p. 367-89 in "Atomic Energy and Agriculture" Publication No. 49, Comar, C. L., ed. Washington, D. C., American Association of Advancement of Science, 1957.

Grain, flour and meal irradiation for the control of insect infestation is discussed in the section dealing with the design of facilities (p. 371-2).

1532 Chamberlain, W. E. AMF (AMERICAN MACHINE AND FOUNDRY CO.) DESIGNS ATOMIC RADIATION UNIT TO KILL INSECTS IN STORED GRAIN. Wall Street Journal, April 5th 1955, 12.

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 16 000 r) in order to obtain effective control of Tribolium.

1533 Crean, L. E., Isaacs, P. J., Weiss, G. J., Fahnoe, F. RADIATION STERILIZATION - PART IV. APPLICATION OF ISOTOPIC SOURCES TO FOOD AND DRUG STERILIZATION. Nucleonics 11, 12 (1953) 32-7.

The use of fission-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 MeV and to a dose of 25 000 rep to a radical distance of 17.5 cm, about 1 mean-free-path in grain. The net volume of grain irradiated/rod = 977 140 cm^3; exposure time = 1000 s; weight of irradiated grain/rod = 1660 lb; process rate/rod = 5960 lb/h, giving a utilization efficiency = 14.7%.

1534 Darden, E. B., Jr., Maeyens, E., Bushland, R. C. A GAMMA-RAY SOURCE FOR STERILIZING INSECTS. Nucleonics 12, 10 (1954) 60-2.

A Co^{60}-irradiation unit is described which was constructed for the purpose of sterilizing insects, insect larvae, and insect-infested material. Techniques are described for utilizing radiation in large-scale control of the screwworm, and preliminary results are reported. (NSA 8: 6917, 1954)

1535 Duffey, D. FISSION-PRODUCT POTENTIAL OF COMMERCIAL REACTORS AND THEIR PROCESSES. Nucleonics 11, 10 (1953) 8-13.

The exploitation of β- and γ-sources represented by various forms of fission-products from reactors is discussed for several purposes, amongst them the insect control in grain. Future trends are considered.

* Murray 1959 - [1538]

1536 Nehemias, J. V., Brownell, L. E., Meinke, W. E., Coleman, E. W. INSTALLATION AND OPERATION OF TEN-KILOCURIE COBALT-60 GAMMA-RADIATION SOURCE. Amer. J. Phys. 22 (1954) 88-92.

Several 1-5 kc source of γ-radiation are now in use in the United States. Most of these have an irradiation volume similar to the 1 kc source in use at this laboratory. The source recently installed at this laboratory, however, contains 10 kc of Co^{60} and has an inside irradiation volume about 9 inches in diameter and 10 inches long. In addition to this high-flux volume, the entire inside of the cave can be used for lower flux irradiation. With this source, it is possible to produce the relatively large quantities of irradiated materials required for pilot studies of possible biological uses of high-level γ-radiation and provide the flexibility required for chemical studies. One of the main applications of such a source lies in the irradiation of grain and of other agricultural products. (from auth. summary)

* Peredelsky et al. 1958 - [1517]

* Peredelsky et al. (1957) 1959 - [1518]

II-B-3 ECONOMICS

* Baker et al. 1954 - [1241], [1243]

1537 Crowley-Milling, M. C. INSECT CONTROL BY RADIATION (Controversy following publication of Hassett's article). Science 125, 3252 (1957) 853.

In the article "Current status of insect control by radiation" [Science 124, (1956) 1011], Charles C. Hassett gives a table of costs per ton for a 50 000-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 unrepresentative and, in this connection, I would like to call attention to data given by Wolfgang Huber [Western Canner and Packer (Aug. 1956)]. Huber shows that, for a dose of 50 000 r (approximately 0.05 Megarep) 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 unit: "$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 (0.5¢ per pound)." This typographic error unfortunately passed both Science's proof reading and mine. CHARLES C. HASSETT.

* Hannan 1953 - [1251]

1538 Murray, G. S. ECONOMICS OF GAMMA RADIATION PROCESSING. Intern. J. appl. Radiation and Isotopes 5 (1959) 211-5.

The estimates of costs are all related to package irradiation equipment. Where possible, the bulk handling of high rates of throughput as, for example, in disinfestation of grain, could lead to substantial reductions in cost. The γ-rays from Co^{60} and Cs^{137} do not induce radioactivity in any process material.

1539 Siu, R. G. H. FEASIBILITY OF FOOD IRRADIATION. p. 429-35 in "Atomic Energy and Agriculture", Publication No. 49. Comar, C. L., ed. Washington, D. C., American Association for the Advancement of Science, 1957, 450 p.

The requirements for economic feasibility are discussed. An estimate of $0.10 to $1 per ton is given for grain deinfestation.

II-B-4 DETECTION

1540 Anonymous. I RAGGI X AL SERVIZIO DEL GRANO IMMASAZZINATO (X-rays in the service of stored grain). Molini d'Italia 3, 12 (1952) 540. (In Italian)

The use of x-ray equipment to detect infestation of grain is briefly described. (BA 27: 21771, 1953)

1541 Costa, A. G. NOTA SOBRE O MÉTODO DOS RAIOS X PARA A DETECÇÂO DE ATAQUES OCULTOS DE INSECTOS NOS CEREAIS (Note on the use of x-rays in the detection of insect pests in cereals). Brotéria 27, 3 (1958) 117-20. (In Portuguese)

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 Calandra oryzae L., Rhizopertha dominica L., and Sitotroga cerealella Oliv.

1542 Dennis, N. M. TECHNIQUE OF GRAIN ORIENTATION FOR RADIOGRAPHIC ANALYSIS. The Northw. Miller 251, 2, Milling Production Section 7a (1954).

A technique is described for loading individual soda straws with wheat kernels via a small vacuum pump or aspirator. 144 8½ in-straws, holding 45 kernels each and a total of 6480, can be radiographed side by side in a grain x-ray machine on a 14×17 in x-ray film.

1543 Goodhue, R. D., Van Emden, H. F. DETECTION OF STEM BORERS IN GRAMINEAE BY X-RAYS. Plant Pathol. 9, 3 (1960) 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 28 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-Royal sheet film the best exposure factor was 28 kV potential and 30 mAS. (BA 35:35443, 1961)

1544 Johnson, R. K. X-RAYS SPUR INFESTATION CONTROL. Food Engng. 24, 9 (1952) 75-7, 168-70.

X-ray examination provides positive identification of hidden insects in grain and more accurate counting of infested kernels than previous methods. (CA 47: 12739d, 1953)

1545 Milner, M., Lee, M. R., Katz, R. APPLICATION OF X-RAY TECHNIQUE TO THE DETECTION OF INTERNAL INSECT INFESTATION OF GRAIN. J. econ. Ent. 43, 6 (1950) 933-5.

Wheat infested with the rice weevil, Sitophilus oryza, 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.)

1546 Milner, M., Lee, M. R., Katz, R. RADIOGRAPHY APPLIED TO GRAIN AND SEEDS. Food Technol., Lond. 6, 2 (1952) 44-5.

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, 1952)

1547 Milner, M. RECENT DEVELOPMENTS IN METHODS FOR DETECTING INTERNALLY INFESTED WHEAT. Northw. Miller 245, 2 (1951) 1a, 6a-8a, 10a-11a.

Present 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 berberine sulfate 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 simple 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 25: 23195, 1951)

1548 Milner, M., Katz, R., Lee, M.R., Pyle, W.B. APPLICATION OF THE POLAROID-LAND PROCESS TO RADIOGRAPHIC INSPECTION OF WHEAT. Cereal Chem. 30, 2 (1953) 169-70.

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: 27098, 1953)

1549 Monte, G. D. GRAIN INFESTATIONS AS SHOWN BY X-RAYS. Molini d'Italia 9 (1958) 422-3. (In Italian)

1550 Nicholson, J. F., Milner, M., Munday, W. H., Kurtz, O. L., Harris, K. L. AN EVALUATION OF FIVE PROCEDURES FOR THE DETERMINATION OF INTERNAL INSECT INFESTATION OF WHEAT. V. THE USE OF X-RAYS. J. Ass. off. agric. Chem. 36, 1 (1953) 146-50.

The examination for total insect damage is time consuming (1 - 1.5 h for 100 g of wheat) because suspected kernals must be dissected. Dehydrated insects are not visible. Examination limited to the more extensively (grossly) damaged kernels required 5 - 10 min. The correlation coefficient for grossly damaged kernels compared to the cracking-flotation test was 0.88. In all 173 samples the total x-ray results were 1.5 times that of the cracking-flotation test. (BA 27: 20735, 1953)

1551 Nicholson, J. F., Kurtz, O. L., Harris, K. L. AN EVALUATION OF FIVE PROCEDURES FOR THE DETERMINATION OF INTERNAL INSECT INFESTATION OF WHEAT. VI. INVESTIGATIONS ON THE X-RAY INSPECTION OF WHEAT. J. Ass. off. agric. Chem. 36, 1 (1953) 156-9.

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 radiograph of low contrast but with excellent detail can be obtained from an x-ray head with a glass tube, oil bath, and plastic exit port between target and film at 18 kV and 10 mA. Results with other filters and target tubes are discussed. (BA 27: 20737, 1953)

1552 Nicholson, J. F., Kurtz, O. L., Harris, K. L. X-RAY EXAMINATION FOR THE DETECTION OF INTERNAL INSECT INFESTATION IN CORN. J. Ass. off. agric. Chem. 36 (1953) 993-1001.

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 gross 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, Westinghouse model 475, was used and technical details are given) is the most rapid for an accurate evaluation of internal insect damage.

1553 Pedersen, J. R., Brown, R. A. X-RAY MICROSCOPE TO STUDY BEHAVIOR OF INTERNAL-INFESTING GRAIN INSECTS. J. econ. Ent. 53 (1960) 678-9.

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 behaviour, development and responses 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. Magnifications up to 400 × can be obtained; the instrument operates up to 20 kV at 100 μA.

1554 Shellenberger, J. A., Farrell, E. P., Milner, M., Lloyd, N., Dahm, P. A., Hein, R. E., McFarland, R. H. AN INVESTIGATION OF INSECT FRAGMENT PRODUCTION IN MILLING USING RADIOACTIVE RICE WEEVILS. Northw. Miller 250, 23 (1953) 10a - 3a.

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 P^{32}-labelled adults of the rice weevil, Sitophilus oryza. 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.

1554 Zunick, M. J., Pace, A. X-RAYS SHOW MORE THAN INSECTS. Food Engng 26, 5 (1954) 64-5, 139-40.

General Electric Co. developed a special unit for grain inspection. It has a self-contained, shockproof x-ray generator that is operated from a standard 110-V, 60c output. It is rated at 10-25 kV peak and 5 mA. Controls, sample holder, and film cassette are located at the top of the cabinet (35 in from the floor). A thin beryllium window is used, of sufficiently large diameter to allow a standard 14×17 in x-ray film to be practically covered, thus permitting radiography of a large number of samples with each exposure. Mylar, a low-density plastic, is used for the front of the film cassette and for the sample tray. An industrial, fine-grained 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

* Arifov et al. 1957 - [1238]

1555 Arifov, U. A., Artmeladze, I. D., Baranov, V. A., Chkheidze, T. N., Gumansky, G. A., Klein, G. A., Pashinsky, S. Z., Shchenkov, S. N., Tkhelidze, L. M., Tsetskhaldze, T. V. THE USE OF RADIATION TO KILL SILKWORM COCOONS. 2nd UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 15/P/2321. 27 (1958) 444-50.

The lethal dose of radiation from a Co^{60} 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 cocoons treated by gamma rays are better than those of heat-treated cocoons. The colloidal properties are also changed; in particular, the liophilic and adhesive properties are increased, which in turn give the raw silk better knitting properties. The killing of cocoons by γ-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 cocoons is of special importance. The effects of irradiation on raw silk, as measured by the dynamometer properties of the fibre and viscosity in solution are discussed.

* Bergold 1954 - [314]

1556 Hirobe, T., Oi, H. STUDIES ON SILKWORM BREEDING USING γ-RAYS (Co^{60}). I. Jap. J. Breeding 8 (1958) 200-1. (In Japanese)

* Kipiani and Tsetskhladze 1956 - [1255]

* Nako 1958 - [1213]

1557 Strunnikov, V. A., Gulamova, L. M. DEVELOPING A MULBERRY SILKWORM LINE BY USING RADIATION METHODS IN BREEDING. Vest. Sel'skokhoz nauk. 2, 8 (1957) 143-7. (Russian, summary in English)

1558 Strunnikov, V. A., Gulamova, L. M. AN EXPERIMENT ON BREEDING SEX-LABELED RACES OF THE MULBERRY SILK MOTH BY USING X-RAYS. p. 207-11 in "Application of Radioactive Isotopes in the Food and Fishing Industries and in Agriculture. A portion of the Proceedings of the All-Union Scientific and Technical Conference on the Application of Radioactive Isotopes. Moscow 1957". New York, Consultants Bureau, Inc. 1959.

Since males produce 20-30% more silk than females, successful breeding of sex-labelled races would lead to a 10-15% increase in silk content of live cocoons when only males are cultivated. A greatly increased yield from the rearing houses would further result from the inherently greater (10-15%) viability of the male compared with the female. An industrial increase of approximately 20-25% may thus be envisaged. Experimental work is described in which female pupae of the bivoltine breed SANIISh (Central Asian Sericulture Research Institute) No. 111 (characterized by dark grain) were irradiated with x-rays (2000, 2500, 3000, 3500 and 4000 r) at 90 r/min. The moths were then paired with non-irradiated females of breeds with white grain. The hybrids (dark grain) were again paired with normal males. Ultimately, females developed from dark and males from white grain. The viability appears satisfactory, so far. Work continues.

(For detailed abstract see The experimental cultivation of silkworm lines marked according to sex using röntgen rays. p. 6-7 in "Abstracts of papers given at the All-Union Conference on the Application of Radioactive and Stable Isotopes and Radiation in the National Economy and Science. Session: Biology, Medicine and Agriculture. Moscow 2-5 Apr. 1957". AEC-tr-2925 (III). New York, Consultants Bureau, Inc. 1957)

* Tazima 1954 - [961]

1559 Tsetskhladze, T. V., Baranov, V. A., Chikovani, V. E., Chkheidze, T. N., Tkhelidze, L. M. KILLING AND PRESERVATION OF MULBERRY SILK MOTH PUPAE BY GAMMA-RADIATION. p. 213-5 in "Application of Radioactive Isotopes in the Food and Fishing Industries and in Agriculture. A portion of the Proceedings of the All-Union Scientific and Technical Conference on the Application of Radioactive Isotopes. Moscow 1957". New York, Consultants Bureau, Inc. 1959.

1. The technique of preliminary treatment of cocoons is of fundamental importance for the quality of silk thread. The methods now applied of killing of the chrysalis and drying of the cocoons are labour-consuming and to a certain extent deform the membrane of the cocoons, produce a denatured sericin, impair unravelling capacity, reduce the dynamometric properties of the cocoon thread and the yield of raw silk. 2. Investigation of killing the mulberry silkworm chrysalis by γ-radiation showed it to be a promising process. 3. The average lethal dose for the spring fattened chrysalis was 200 000 rep, for the summer one 150 000 rep, and for the autumn one 100 000 rep. In a chrysalis receiving 30-40% of the lethal dose within the first days of radiation and later doses of 1000 rep the stage of metamorphosis was protracted for 10-12 d. 4. The value of the lethal dose depends on the age of the chrysalis; for a one d old chrysalis, 10 to 12 000 rep; for 5 d old ones, 50 000 rep; and from the eighth day, 100-200 000 rep. 5. Tagging of the irradiated parts showed that the dynamometric properties of the silk thread are improved as compared with box-dried cocoons. The raw silk yield was considerably increased. The irradiated cocoons were well preserved under usual storage conditions.

(For detailed abstract see "Killing and preservation of the mulberry silkworm cocoons by γ-radiation." p. 135 in "Abstracts of papers given at the All-Union Conference on the Application of Radioactive and Stable Isotopes and Radiation in the National Economy and Science. Session: Biology, Medicine and Agriculture. Moscow 2-5 Apr. 1957", AEC-tr-2925 (III). New York, Consultants Bureau, Inc. 1957)

II-D Miscellaneous Applications

II-D-1 TIMBER PROTECTION

* Fisher 1958 - [1126]

1560 Holling, C. S. A RADIOGRAPHIC TECHNIQUE TO IDENTIFY HEALTHY, PARASITIZED AND DISEASED SAWFLY PREPUPAE WITHIN COCOONS. Canad. Ent. 90, 1 (1958) 59-61.

In the course of work in Canada on the reactions of small mammal predators to sawfly cocoons containing healthy, parasitized or diseased prepupae, a radiographic method enabling the cocoons to be classified without being opened was found useful and is described. The radiographs permitted the detection within cocoons of Neodiprion sertifer (Geoff.), of Dahlbominus fuscipennis (Zett.), larvae or pupae of Exenterus

candensis Prov., sawfly prepupae attacked by fungus, and healthy prepupae, and 200 cocoons (subsequently dissected) were correctly classified from them. The technique was also used successfully with cocoons of N. lecontei (Fitch), N. pratti banksianae Rohw., and N. swainei (Middleton).

* Kloft and Ehrhardt 1959 - [26]

1561 Paton, J. M., Hearmon, R. F. S. EFFECT OF EXPOSURE TO GAMMA-RAYS ON THE HYGROSCOPICITY OF SITKA SPRUCE WOOD. Nature 180, 4587 (1957) 651.

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 only affected by very heavy doses of radiation. The effect is negligible below 10^7 rad. Thus, any doses used for controlling wood-boring insects in practice are unlikely to have any significant physical effect on the wood itself.

1562 Sandermann, W., Casten, R. STUDIEN AUF DEM GEBIETE DER HOLZSCHUTZCHEMIE. 6. MITTEILUNG: UNTERSUCHUNGEN ÜBER DIE VERWERTBARKEIT RADIOAKTIVER ABFALLSTOFFE VON ATOMKRAFTWERKEN ALS HOLZSCHUTZMITTEL (Studies in the chemistry of wood protection. Sixth report: Investigating the exploitability of radioactive waste products from nuclear power plants for purposes of wood protection). Holz als Roh- u. Werkst. 14, 1 (1956) 11-14. (In German)

Zr^{95} and Ce^{144} have too short a half-life, whereas Cs^{137} has a sufficiently long half-life but does not form salts which prove difficult to dissolve. Sr^{90} was used because it has an acceptable half-life and forms barely-soluble sulphate. Only paper impregnated with Sr^{90}-nitrate solution of 1 mc/cm^3 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 65 years then impregnation would have to start with an activity of 8 mc/cm^3, i. e. 8 times the acceptable limit, thus greatly endangering man and warm-blooded animals, particularly in view of the fact that Sr^{90} is stored in the bone.

II-D-2 VARIOUS

1563 Hills, P. R., Roberts, R., Spindler, M. W. A COMPARISON OF THE PRODUCTION OF THE INSECTICIDE "GAMMEXANE" (1:2:3:4:5:6-HEXACHLOROCYCLOHEXANE) BY ULTRA-VIOLET AND Co^{60} GAMMA RADIATION. p. 61 in "Large Radiation Sources in Industry. Conference Proceedings, Warsaw 8 - 12 Sep. 1959", Vol. 2. Vienna, International Atomic Energy Agency, 1960.

A comparative study has been made of the synthesis of the γ-isomer of 1:2:3:4:5:6-hexachlorocyclohexane "Gammexane", both by ultraviolet and Co^{60} γ-radiation. Experiments with light of wave length 3650 A, employing a variety of experimental conditions, have established an optimum quantum yield of 8.67×10^3 for the production of the hexachloro compound which contains 13.2 ± 1.3% of the γ-isomer. The introduction of additives did not improve either the γ or γ-isomer yield. For radiation initiated experiments the "Gammexane" content is 15.3 ± 1.6% and is independent of dose rate, benzene concentration and duration of the chlorination process. Reaction at low temperatures effects small improvements in the γ-isomer yield. A comparison of both methods of initiation shows that the absorbed energy is utilized with equal efficiency in each case.

1564 Katznelson, H., Jamieson, C. A., Lawton, E. J., Bellamy, W. D. STUDIES ON THE TREATMENT OF CONTAMINATED COMBS AND HONEY WITH HIGH VELOCITY ELECTRONS. Canad. J. Res., C- Canad. J. Technol. 30 (1952) 95-103.

1565 Studier, H., Studier, R. THE STERILIZATION OF AMERICAN FOULBROOD BY IRRADIATION WITH GAMMA RAYS. Amer. Bee J. 98 (1958) 192.

ADDENDUM

NEMATODES

A Radioisotope Studies

1566 Dropkin, V. H., King, R. C. PLANT PARASITIC NEMATODES HOMOGENEOUSLY LABELED WITH RADIOPHOSPHORUS. Expt. Parasitol. 5, 5 (1956) 469-80.

A quantitative study has been made of the volume and P content of root-knot and golden nematodes (Meloidogyne incognito acrita and Heterodera rostochiensis) during different stages of their life cycles. Galled tissues of plants infested with root-knot nematodes have accumulated P^{32} from labelled nutrient at a lower rate than uninfected roots of the same plant. Infection in one part of a root system, therefore, does not impair the ability of uninfected roots of the same plant to take up P. The P content of the nematode population of an infected tomato plant makes up no more than 10% of the total P of the plant. It follows that the unhealthy condition of the plant is not caused by the parasite "robbing" the host of this vital element. Less P is translocated out of gall roots than out of ungalled roots.

1567 Hunter, A. H. NUTRIENT ABSORPTION AND TRANSLOCATION OF PHOSPHORUS AS INFLUENCED BY THE ROOT KNOT NEMATODE (MELOIDOGYNE INCOGNITO ACRITA). Soil Sci. 86 (1958) 245-50.

Greenhouse experiments with tomato plants grown in nutrient solution indicated that the observed detrimental effects of the root-knot nematode on growth cannot be attributed to an interference with the absorption or translocation of N, K, Ca, Mg, Fe, Cu or P. Although the rate of P absorption as indicated by use of P^{32} was reduced in the infected plants, the total percentage of P content of infected plants was higher than in normal plants. (CA 53: 17405a, 1959)

1568 Oteifa, B. A., Barrada, Y., El Gindi, D. M. AN APPROACH FOR USING LABELLED RADIOACTIVE PHOSPHORUS IN PHYSIO-PATHOLOGICAL STUDIES OF PLANT NEMATODE DISEASES. 2nd UN International Conference on the Peaceful Uses of Atomic Energy, A/CONF. 15/P/1494. 27 (1958) 48-50.

P^{32}-labelled ($KH_2P^{32}O_4$) nutrient solution was used to study the effects of the root-knot nematode, Meloidogyne javanica (Chitwood) on the physio-pathological status of tomato plants, Lycopersicum esculentum Mill. The phosphorus content and the physiological route of the element through host tissue were affected. The root parasitic nematodes incite gall formation. An infection in the early stages of plant growth makes the host utilize its energy in the production of new lateral rootlets, i. e. meristematic tissue capable of absorbing more nutrient. The new rootlets then become infected with the newly hatched larvae. Extensive gall formation subsequently causes a reduction in the root absorptive surface. The presence and activity of the parasite in the root interfere with the translocation of nutrient. Phosphorus uptake by the nematode is, however, only 10%. Reasons for the interference are discussed.

B Ionizing Radiation Studies

1569 Anonymous. RADIATION OUT AS NEMATOCIDE. J. agric. Food Chem. 6, 8 (1958) 567.

USDA scientists are disappointed to find that nematodes can withstand large doses of radiation. It takes 120 000 r to kill the golden nematode, up to 20 000 r to sterilize the female. Some other nematodes require 350 000 to 640 000 r before giving up the ghost. (Humans will invariably die from a 650-r dose.) Plants cannot withstand the dosage necessary to kill nematodes, so there is no prospect that radiation can be used for killing nematodes on living plants. (from Research Newsletter)

1570 Fassuliotis, G. EFFECTS OF IONIZING RADIATIONS ON THE GOLDEN NEMATODE, HETERODERA ROSTOCHIENSIS. Radiation Res. 9 (1958) 112-3.

The golden nematode, H. rostochiensis, is a parasite of potatoes and tomatoes. The resistant stage of the nematode, the cyst, containing several hundred embryonated eggs, was irradiated with x-rays from a G. E.

Maxitron 250 delivering a dose rate of 1000 r/min and with γ-rays from a Co^{60} source emitting 670 000 r/h at the Brookhaven National Laboratory, Upton, New York. The doses were 5, 10, 20, 40, 80, 160, 320, 640 and 1280 kr. Hatching tests from cysts exposed to both types of radiations revealed a disturbance in the response of the larvae, after a dose of 160 kr and above. A delay in the onset of hatching and a reduction in the total number of larvae emerging from the cysts resulted. No larvae hatched after 640 kr; they were found to be in a moribund condition one week after irradiation. Injury resulting in abnormal body movements became apparent after 80 kr. Eighty-four per cent of the females developing from larvae irradiated with 20 kr were sterilized, 98% after 40 kr, and 100% after 80 kr. However, no larvae hatched from the 20 and 40 kr-females. Viability was not altered in developing females following postirradiation storage of irradiated cysts for 6 months at 40°F. Chromosome aberrations in the form of fragments and bridges at anaphase were found in maturing eggs recovered from females which developed from irradiated larvae.

(Abstract of paper presented at the Intern. Congr. of Radiation Res., Burlington, Vermont, 10-16 Aug. 1958)

1571 Fassuliotis, G. OBSERVATIONS ON THE BIOLOGICAL EFFECTS OF IONIZING RADIATIONS ON THE LIFE CYCLE OF HETERODERA ROSTOCHIENSIS WOLLENWEBER, 1923. Ph. D. Thesis, New York Univ. 1958.

1572 Fassuliotis, G., Sparrow, A. H. PRELIMINARY REPORT OF X-RAY STUDIES ON THE GOLDEN NEMATODE. Plant Dis. Reptr. 39, 7 (1955) 572.

Data were obtained which indicate that the life cycle of Heterodera rostochiensis is interrupted by x-rays at dosages of 20 000 r and above. The lowest dose found to inhibit the development of embryonated eggs is the same as the dose found to inhibit completely the sprouting of potatoes. Although the nematode data were obtained from free cysts, the results indicate that irradiation of tubers infected with the golden nematode will not only inhibit sprouting, but will probably also interrupt the life cycle of the parasite, thus eliminating one of the possible routes of spread of the golden nematode.

1573 Myers, R. F., Dropkin, V. H. EFFECTS OF X-RAYS AND γ-IRRADIATION ON SOIL AND PLANT-PARASITIC NEMATODES. Radiation Res. 9 (1958) 158.

Ten genera of plant parasitic and three genera of free-living nematodes were exposed to graded doses of radiation. Pot experiments showed that some genera required up to 160 000 rep for complete sterilization, whereas other genera were sterilized at doses between 20 000 and 40 000 rep. Dosages necessary to kill 50% of Panagrellus silusiae adults in culture within 24 h were between 400 000 and 500 000 rep. Similar dosages killed Tylenchorhynchus claytoni in pot experiments. A marked reduction in population size of cultures and pot experiments was noted at dosages well below the sterilizing dose. A high percentage of embryos of Panagrellus were killed at 5000 r. The ability of nematodes to survive large doses of irradiation is probably correlated with the cell constancy in these forms. The dosage necessary to sterilize plant parasitic nematodes is too high to make radiation a feasible tool for soil sterilization or for treatment of living plants.

(Abstract of paper presented at the Intern. Congr. of Radiation Res., Burlington, Vermont, 10-16 Aug. 1958)

1574 Myers, R. F., Dropkin, V. H. IMPRACTICABILITY OF CONTROL OF PLANT PARASITIC NEMATODES WITH IONIZING RADIATIONS. Plant Dis. Reptr. 43, 3 (1959) 311-3.

Irradiation of 11 species of plant parasitic nematodes indicates that the dose required for complete sterilization is variable; reproduction being completely stopped with doses of 40 000 r in only one species. For six other species, doses above 160 000 r were required to stop reproduction. However, a large reduction in the reproduction of most species can be achieved with a dose of 80 000 r. The irradiation of nematodes in field soil with a Co^{60} source is not practical because of the length of time required to irradiate even small areas. Since damage to plant roots occurs at levels of irradiation below those required to disrupt the nematode's life cycle, control of plant parasitic nematodes in and on plant roots by ionizing radiations is not feasible. (auth.)

1575 Myers, R. F. THE SENSITIVITY OF SOME PLANT-PARASITIC AND FREE-LIVING NEMATODES TO GAMMA AND X-IRRADIATION. Nematologica 5 (1960) 56-63.

The sterilizing effect of ionizing rays was examined on 14 free-living and plant-parasitic nematodes. Reductions in population could be obtained with considerably lower doses than those required for complete sterilization. The embryonic stage is the most sensitive stage in the developmental cycle of Panagrellus silusiae. Larvae and adults support much higher doses. Cell division took place up to 320 000 r provided

the gonads were already formed. In Tylenchorhynchus claytoni cells matured up to 500 000 r as judged from an increase in length, and the formation of vulva and spicula. Body changes due to radiation could take the form of an increase or decrease in body length. These opposite effects were due to damage which prevented uptake of nourishment, or to sterilization without accompanying effect on food intake. Morphological changes occurred in both cases, and include cuticular and internal damage.

1576 Weischer, B. DIE WIRKUNG IONISIERENDER STRAHLEN AUF DIE ENTWICKLUNG VON HETERODERA ROSTOCHIENSIS UND H. SCHACHTII (The effects of ionizing rays on the development of Heterodera rostochiensis and H. schachtii). Nematologica 2 (1957) 300-5. (In German)

Cysts of the golden and the turnip nematode were subjected to radiation from a radium source. The dose was of the order of 400 r/h. Only after 72 h irradiation could any effect be observed. The duration of treatment was extended to 196 h for the experiments. Hatching of larvae was speeded up in the case of the golden nematode, and slowed down for the turnip nematode. The former is, however, interpreted as a pathological stimulus which significantly reduced vitality. This may be seen in experiments on infectivity extended over two generations.

1577 Wood, F. C., Goodey, J. B. EFFECTS OF GAMMA RAY IRRADIATION ON NEMATODES INFESTING CULTIVATED MUSHROOM BEDS. Nature 180 (1957) 760-1)

Nematodes in a compost from infested mushroom beds were identified as Ditylenchus destructor and Saprobes, mostly Rhabditis spp. Duplicated 200 g samples were subjected to doses of 6000, 12 000, 24 000, 48 000 and 96 000 rep of γ-radiation from a Co^{60}-source. The inactivation dose for these nematodes appears to lie between 48 000 and 96 000 rep, more than twice as great as the 10 000 - 20 000 r found to inactivate cysts of potato-root nematode (Heterodera rostochiensis) (see Fassuliotis and Sparrow, Plant Disease Reporter 39 (1956) 572).

APPENDIX

TABLE Ia

DISPERSAL OF RADIOISOTOPE-MARKED FOREST INSECTS

Insect	Isotope	No. released	Recovery and longevity	Maximum dispersal (km)	Authority
White Pine Weevil					
Pissodes strobi	Co^{60}	64	33% in 60 d	--	[101]
" "	Sc^{46}	1600	60 - 70% up to 8.5 months	0.22	[99]
Douglas Fir Beetle					
Dendroctonus pseudotsugae	P^{32}	--	--	--	[260]
Southern Pine Beetle					
Dendroctonus frontalis	Ir^{192}	20 000	--	--	[371]
Engelmann Spruce Beetle	P^{32}	19 000	5% up to 14 d	--	[354]
Dendroctonus engelmanni	I^{131}				
" "	--	--	--	4.8	[98]
European Pine Shoot Moth					
Rhyacionia buliana	Co^{60}	104	42.9	0.046	[123]
White grubs	Ta^{182}	Movement in soil		--	[371]

Jenkins, D.W. Table II in "Radioisotopes in ecological and biological studies of agricultural insects." p. 3 - 21 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay 5 - 9 December 1960". Vienna, IAEA. 1962, 307.

TABLE Ib

DISPERSAL OF RADIOACTIVE-MARKED ORCHARD INSECTS

Insect	Isotope	No. released	Longevity	Maximum dispersal (km)	Authority
Plum curculio *Conotrachelus nenuphar*	P^{32}	62	up to 120 d	0.11	[369] [370]
" "	Co^{60}	705	up to 8.5 months	0.27	" "
" "	Zn^{65}	23	up to 120 d	0.041	" "
" "	Sr^{89}	175	3 d	0.123	" "
" "	I^{131}	86	--	0	" "
Oriental Fruit Fly *Dacus dorsalis*	P^{32}	--	up to 40 d	--	[95]
Fruit Fly *Drosophila melanogaster*	P^{32}	20 000	--	3.84	[97]
Mediterranean Fruit Fly *Ceratitis capitata*	P^{32}	944	--	32.0	[92]
Cherry Fruit Fly *Rhagoletis cingulata*	P^{32}	2010	up to 42 d	0.287	[93]
Walnut Husk Fly *Rhagoletis completa*	P^{32}	15% of natural population	--	14.4	[91]

Jenkins, D.W. Table III in "Radioisotopes in ecological and biological studies of agricultural insects." p. 3 - 21 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay 5 - 9 December 1960". Vienna, IAEA. 1962, 307.

TABLE Ic

DISPERSAL AND FLIGHT RANGE OF RADIOACTIVE-MARKED MOSQUITOES

Species	Locality	No. mosquitoes released × 1000	% Recovery	Maximum flight range (km)	Reference
Aedes communis	Churchill	3000	0.005	1.6	JENKINS and HASSETT [110]
Aedes flavescens	Saskatchewan	—	—	0.16	SHEMANCHUK et al. [348]
" "	Saskatchewan	415	0.02	10.5	Ibid. [115]
Aedes nigromaculis	California	400	0.12	3.0	THURMAN and HUSBANDS [118]
Aedes spencerii	Saskatchewan	—	—	0.023	SHEMANCHUK et al. [348]
Aedes taeniorhynchus	Florida	1000	0.03	32.0	PROVOST [111]
" "	Florida	1560	0.12	40.0	Ibid. [112]
" "	Georgia	2000	0.023	32.6	BIDLINGMAYER and SCHOOF [108]
Anopheles bellator	Brazil	3	—	0.8	ARAGÃO et al. [343] [107] [344]
Anopheles gambiae	Tanganyika	60	0.5	3.8	GILLIES [771]
Culex tarsalis	California	10	—	1.6	THURMAN and HUSBANDS [118]
Psorophora confinnis and P. discolor	Arkansas	50 —	0.09 —	9.6 2.4	QUARTERMAN et al. [114]

Jenkins, D.W. Table VI in "Radioisotopes in entomological studies of endemic and tropical diseases." p. 233-66 in "Radioisotopes in Tropical Medicine. Proceedings of a Symposium, Bangkok, 12 - 16 December 1960". STI/PUB/31, Vinna, IAEA. 1962, 379p.

TABLE Id

DISPERSAL AND FLIGHT RANGE OF RADIOACTIVE-MARKED FLIES

Locality	Habitat	No. flies released × 1000	% Recovery	Maximum flight range (km)	Reference
Housefly Musca domestica					
Oregon	Rural	36	4.6	19.2	LINDQUIST et al. [74]
Oregon	Rural	54	2.78	32.0	YATES et al. [90]
Arizona	City	31	0.73	4.8	SCHOOF et al. [80]
Arizona	City	56	0.51	8.0	SCHOOF et al. [80]
Arizona	City	342	1.8	14.4	SCHOOF and SIVERLY [82]
Georgia	Rural	13.5	8.0	13.1	QUARTERMAN et al. [78]
Georgia	City	40	0.24	12.2	QUARTERMAN et al. [79]
Blowfly Phormia regina					
Oregon	Rural	1.2	14.0	12.8	LINDQUIST et al. [74]
Oregon	Rural	60	2.64	44.8	YATES et al. [90]
West Virginia	City	16	0.06	16.5	SCHOOF and MAIL [81]
Georgia	City	--	--	6.4	QUARTERMAN et al. [79]

Jenkins, D.W. Table VII in "Radioisotopes in entomological studies of endemic and tropical diseases." p. 233-66 in "Radioisotopes in Tropical Medicine. Proceedings of a Symposium, Bangkok, 12 - 16 December 1960". STI/PUB/31, Vienna, IAEA. 1962, 379p.

TABLE II

RADIATION STERILIZATION OF MEDICALLY-IMPORTANT INSECTS

Dosage (r)	Stage irrad.	% Sterility and egg laying	Insect	Reference
2500	male pupae	100%; few sterile eggs laid	Callitroga hominivorax	BUSHLAND and HOPKINS [1111]
5000	female pupae	100%; few sterile eggs laid	Ibid.	BUSHLAND and HOPKINS [1111]
8050	adults	few fertile eggs	Drosophila	HASSETT and JENKINS [1252]
16100	adults	100%; no eggs	Ibid.	HASSETT and JENKINS [1252]
3200	pupae	few eggs	Anopheles quadri-maculatus	DAVIS et al. [1116]
6400	pupae	50% reduction of sterile eggs	Ibid.	DAVIS et al. [1116]
12900	pupae	no decrease in fertile eggs	Ibid.	DAVIS et al. [1116]
8865	pupae	2% eggs hatched	Ibid.	DAVIS et al. [1116]
5000	adults	66% decrease in eggs, 89% hatch	Ibid.	DAVIS et al. [1116]
8865	adults	100% sterile, few eggs, no hatch	Ibid.	DAVIS et al. [1116]
10000	nymph	9 - 82% eggs hatched	Pediculus humanus	COLE et al. [888]
10000	adult	100%, no hatch	Ibid.	COLE et al. [888]

Jenkins, D.W. Table III in "Radioisotopes in entomological studies of endemic and tropical diseases." p. 233 - 66 in "Radioisotopes in Tropical Medicine. Proceedings of a Symposium, Bangkok, 12 - 16 December 1960". STI/PUB/31, Vienna, IAEA. 1962, 379 p.

TABLE III

MORTALITY OF IRRADIATED INSECTS OF MEDICAL INTEREST

Insect	Radiation	Dosage (r)	Mortality (%)	Time (days)	Reference
Aedes aegypti (adult)	x	20 000	50	18	TERZIAN [1333]
Ibid.	x	30 000	50	12	Ibid.
Ibid.	x	40 000	50	9	Ibid.
Ibid.	x	20 000	100	30	Ibid.
Ibid.	x	30 000	100	21	Ibid.
Ibid.	x	40 000	100	12	Ibid.
Drosophila adult (fasted)	B	60 000	100	1	KING and WILSON [1319]
Ibid. (fed)	B	60 000	60	14	Ibid.
Ibid.	γ	64 000	100	21	HASSETT and JENKINS [1252]
Ibid.	γ	193 000	100	2	Ibid.
Blattella germanica (60 days)	γ	72 000	14	--	Ibid.
Musca domestica egg	γ	130	50	1	COLE et al. [888]
Ibid. larva	γ	1 300	50	1	Ibid.
Ibid. pupae	γ	15 000	50	1	Ibid.
Ibid. male	γ	72 000	50	1	Ibid.
Ibid. female	γ	110 000	50	1	Ibid.
Pediculus h. humanus egg	γ	24 000	50	1±	Ibid.
Ibid. nymph ♂/♀	γ	170 000	50	1±	Ibid.
Blattella germanica nymph ♂/♀	γ	76 000	50	2	Ibid.
Periplaneta americana nymph	γ	28 000	50	1	Ibid.
Ibid. adult	γ	50 000	50	1	Ibid.

Jenkins, D.W. from Table IV in "Radioisotopes in entomological studies of endemic and tropical diseases." p. 233 - 66 in "Radioisotopes in Tropical Medicine. Proceedings of a Symposium, Bangkok, 12 - 16 December 1960". STI/PUB/31, Vienna, IAEA. 1962, 379 p.

TABLE IV

REFERENCES FOR THE SYNTHESIS OF SOME RADIO-LABELLED ORGANIC INSECTICIDES AND RELATED COMPOUNDS

Common name	Chemical name and isotope	Reference
Chlorinated Hydrocarbon		
Endrin	1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4-endo, endo-5, 8-dimethanonaphthalene-6, 7-C^{14}	[497]
DDT	2, 2-bis-(p-chlorophenyl)-1, 1, 1-trichloro-2-C^{14}-ethane 2, 2-bis-(p-chlorophenyl-4, 4′-C^{14})-1, 1, 1-trichloroethane	[463] [480] [483] [465]
Thiodan	6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-methano-2, 4, 3-benzodioxathiepin-3-oxide-5a, 9a-C^{14}_2	[501]
Organophosphorus		
Co-Ral	O, O-diethyl O-3-chloro-4-methylumbelliferone-P^{32}-phosphorothioate	[514]
Demeton	O, O-diethyl S(and O)-2-(ethylthio)ethyl-P^{32}-phosphorothioate	[634]
DDVP	O, O-dimethyl 2, 2-dichlorovinyl-P^{32}-phosphate	[554] [555]
Diazinon	O, O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl)-P^{32}-phosphorothioate	[542]
Dimethoate	O, O-dimethyl S-(N-methylcarbamoylmethyl)-P^{32}-phosphorodithioate	[552]
Dipterex	O, O-dimethyl 1-hydroxy-2, 2, 2-trichloroethyl-P^{32}-phosphonate	[554] [555]
Malathion	O, O-dimethyl S-(1, 2-dicarbethoxyethyl)-P^{32}-phosphorodithioate	[567] [566]
Parathion	O, O-diethyl O-(p-nitrophenyl)-P^{32}-phosphoro-S^{35}-thioate O, O-diethyl O-(p-nitrophenyl) phosphoro-S^{35}-thioate	[575] [578]
Ronnel	O, O-dimethyl O-(2, 4, 5-trichlorophenyl)-P^{32}-phosphorothioate	[601]
Carbamate		
Sevin	1-naphthyl-1-C^{14}-N-methyl carbamate	[706]
Pyrethroid		
Allethrin	d, l-allelrethonyl-d, l-cis, trans-2-C^{14}-chrysanthemate d, l-3-allyl-2-C^{14}-methyl-4-oxo-2-cyclopenten-1-C^{14}-yl chrysanthemate	[667] [679]
Synergist		
Piperonyl Butoxide	α-[2-(2-butoxyethoxy)ethoxy]-4, 5-methylenedioxy-2-propyltoluene-1-C^{14}-methylene	[676]
Repellent		
Deet	N, N-diethyl-m-toluamide (C^{14}-carboxy)	[714]

Hopkins, T.L. Table I of "Radioisotope Techniques and Recent Research on Metabolism of Insecticides in Insects." p. 101 - 111 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay 5 - 9 December 1960". Vienna, IAEA. 1962, 307.

TABLE V

RADIOTRACER STUDIES ON THE METABOLISM OF ORGANOPHOSPHATE INSECTICIDES BY PLANTS

(Abbreviations: Me = methyl, Et = ethyl, Ph = phenyl, antiChE = anticholinesterase agent or cholinesterase inhibitor)

No.	Structure and name	Absorption and translocation	Hydrolysis products	Non-hydrolysed metabolites
1	$(MeO)_2P(O)OCH = CCl_2$ DDVP	pea [555]	pea [555]	
2	$(MeO)_2P(O)OC(Me) =$ $CHC(O)OMe$ Phosdrin or OS 2046 alpha and beta isomers studied separately	Bryophyllum, cucumber, pea [660]	pea [1441] [660]: bean, Bryophyllum, corn, cucumber [660]: plants; $(MeO)_2P(O)OH$? and $(MeO)_2P(O)OC(Me) = CHC(O)OH$? [660]: pea; $(MeO)_2P(O)OH$ and $(MeO)_2P(O)OC(Me) = CHC(O)OH$ [598]	None in plants [1441] [660]
3	$(MeO)_2P(O)OC(Me) =$ $CHC(O)OH$ Carboxylic acid hydr. prod. of alpha Phosdrin		pea; $(MeO)_2P(O)OH$ and $(MeO)(HO)P(O)OC(Me) = CHC(O)OH$ [598]	
4	$(MeO)_2P(O)OCHBr \cdot CCl_2Br$ Dibrom		plants?; $(MeO)_2P(O)OH$, $BrCl_2C \cdot CHO$, $Cl_2HC \cdot CHO$, and complex amino acid conjugates	plants?; $(MeO)_2P(O)OCH = CCl_2$
5	$(MeO)_2P(O)CHOH \cdot CCl_3$ Dipterex, Dylox, Bayer L 13/59	pea [555]	pea [555]	
6	$(MeO)_2P(O)\underset{\displaystyle CCl_3}{\overset{\displaystyle |}{C}}HOC(O)Me$ acetylated Dipterex	pea [555]	pea [555]	
7	$(MeO)_2P(O)SC_2H_4SEt$ methyl isosystox, thiol isomer of meta-Systox		many plants; $(MeO)_2P(O)OH$, H_3PO_4 and lecithins [645]	many plants; $(MeO)_2P(O)SC_2H_4S(O)Et$ and $(MeO)_2P(O)SC_2H_4S(O_2)Et$ [645]
8	$(MeO)_2P(O)SC_2H_4S(O)Et$ sulphioxide of methyl isosystox		cabbage, potato; $(MeO)_2P(O)OH$, H_3PO_4 and lecithins [645]	cabbage, potato; $(MeO)_2P(O)SC_2H_4S(O_2)Et$ [645]

TABLE V (cont'd)

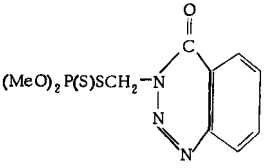
No.	Structure and name	Absorption and translocation	Hydrolysis products	Non-hydrolysed metabolites
9	$(MeO)_2P(O)SC_2H_4S(O_2)Et$ sulphone of methyl isosystox		cabbage, potato; $(MeO)_2P(O)OH$, H_3PO_4 and lecithins [645]	
10	$(MeO)_2P(S)OPh{-}NO_2{-}4$ methyl Parathion	many plants [574]	many plants [574]: hydrangea; H_3PO_4 and unident. metabolites [574]	
11	$(MeO)_2P(S)OPh{-}S(O)Me{-}4$ Bayer 25198	cotton [657]	cotton [657]	
12	 Guthion, Gusathion, Bayer 17147	cotton [562]	cotton; hydr. prod's including phosphatides [562]	cotton; two strongly lipophilic unident. metabolites, of unknown toxicity, but no apparent P = O Guthion [562]
13	$(MeO)_2P(S)SCH_2C(O)NHMe$ Dimethoate, Rogor	corn, cotton, pea, potato [551]	corn, cotton, potato; $(MeO)_2P(O)OH$, $(MeO)_2P(S)OH$, $(MeO)(HO)P(S)CH_2C(O)NHMe$, and $(MeO)_2P(O)SCH_2C(O)OH$ [551]: pea; as above plus H_3PO_4 [551]	corn, cotton, pea, potato $(MeO)_2P(O)SCH_2C(O)NHMe$ [551] bean, lettuce; $(MeO)_2P(O)SCH_2C(O)NHMe$? and a less polar antiChE-agent [763]
14	$(CH_3O)_2P(S)SCH_2C(O)NHEt$ CL 18,706	cotton [551]	cotton [551]	
15	$(MeO)_2P(S)SCH\cdot C(O)OEt$ $CH_2C(O)OEt$ Malathion	bean [50]	bean; $(MeO)_2P(S)OH$, H_3PO_4, $(MeO)_2P(S)SH$?, $(MeO)_2P(S)SCH\cdot(CO)OH$ and $CH_2C(O)OH$ $(MeO)_2P(S)SCH\cdot C(O)OH$ $CH_2C(O)OEt$?	bean; $(MeO)_2P(O)SCH\cdot C(O)OEt$? $CH_2C(O)OEt$
16	$(EtO)_2P(O)SC_2H_4N(Et)_2$ Amiton	cotton, lemon [664]	cotton, lemon [664]	none in plants [664]

TABLE V (cont'd)

No.	Structure and name	Absorption and translocation	Hydrolysis products	Non-hydrolysed metabolites
17	$(EtO)_2P(O)SC_2H_4N(Et)_2 \cdot HX$ salts of Amiton (Tetram or Chipman R-6199 is hydrogen oxalate salt)	cotton; citrate, dimethyl sulphate, oxalate, picrate, phthalate, p-toluene sulphonate, trichloroacetate salts [644]: lemon; dimethyl sulphate, hydrochloride, oxalate, p-toluene sulphonate salts [644]: orange; oxalate salt [644]: cacao; p-toluene sulphonate salt [658]	cotton, lemon; oxalate salt [644]: cacao; p-toluene sulphonate salt [658]	none in plants [644] [658]
18	$(EtO)_2P(O)SC_2H_4S(Me)Et \cdot MeSO_4$ dimethyl sulphonium salt of isosystox	cotton, lemon [642]		cotton; unidentified metabolite [642]
19	$(EtO)_2P(O)SC_2H_4SEt$ and $(EtO)_2P(S)OC_2H_4SEt$ Systox Demeton (mixed isomers)	cotton [630] [732]: lemon [756]	many plants; field residue data [643]: plants; $(EtO)_2P(O)OH$?, alcohols? [643]	apple, orange, walnut; $(EtO)_2P(O)SC_2H_4S(O)Et$, $(EtO)_2P(O)SC_2H_4S(O_2)Et$?, $(EtO)_2P(S)OC_2H_4S(O)Et$ plus $(EtO)_2P(S)OC_2H_4S(O_2)Et$ and/or $(EtO)_2P(O)OC_2H_4S(O)Et$ [643]
20	$(EtO)_2P(O)SC_2H_4SEt$ isosystox, thiol isomer of Systox or Demeton	cotton, lemon [644] [642]: bean, lemon [641]: potato, tobacco [646]: bean, borage, mustard [648]: apple, bean, coleus [649]: lettuce, nettles [620]: alfalfa, cotton, sugar beet [595]: cotton [755]	cotton [644]: bean, cotton [646] [647]: orange [643]: potato, tobacco [646] [647]: bean, borage, mustard [648]: apple, bean, coleus [649]: lettuce, nettles [620]: alfalfa, cotton, sugar beet [595]: cotton [755]	orange; $(EtO)_2P(O)SC_2H_4S(O)Et$, $(EtO)_2P(O)SC_2H_4S(O_2)Et$ [643]: cotton; $(EtO)_2P(O)SC_2H_4S(O)Et$, $(EtO)_2P(O)SC_2H_4S(O_2)Et$ [642] [635] [636]: Brassica, nettles, sugar beet, turnip; 3 unidentified metabolites [638]: bean, lettuce; unidentified metabolite(s) [641]; potato, tobacco; unidentified "more toxic" compounds [646]: bean, borage, mustard; 2 unidentified metabolites [648]: lettuce, nettles; $(EtO)_2P(O)SC_2H_4S(O)Et$ plus 1 unidentified oxidative metabolite plus 2nd unidentified metabolite [620]

TABLE V (cont'd)

No.	Structure and name	Absorption and translocation	Hydrolysis products	Non-hydrolysed metabolites
21	$(EtO)_2P(O)SC_2H_4S(O)Et$ sulphoxide of isosystoc	cotton, lemon [642]	cotton [642]	cotton; $(EtO)_2P(O)SC_2H_4S(O_2)Et$ [642]
22	$(EtO)_2P(S)OC_2H_4SEt$ Systox or Demeton	cotton, orange [643]: bean, lemon [641]: turnip [620]: many plants [651]	bean, cotton, orange [643]	orange; $(EtO)_2P(S)OC_2H_4S(O_2)Et$, $(EtO)_2P(O)OC_2H_4S(O)Et$ [643]: plants; unidentified metabolite(s) [638]: bean, lemon; unidentified metabolite(s) [641]: cotton; $(EtO)_2P(S)OC_2H_4S(O)Et$ plus $(EtO)_2P(S)OC_2H_4S(O_2)Et$ and/or $(EtO)_2P(O)OC_2H_4S(O)Et$ [635]: turnip; 3 unidentified metabolites [620]
23	$(EtO)_2P(S)OC_2H_4N(Et)_2$ thiono isomer of Amiton	cotton, lemon [644]	cotton, lemon [644]	
24	$(EtO)_2P(S)SCH_2SEt$ Thimet or Phorate	many plants [589]: alfalfa, cotton, sugar beet [595]: alfalfa, cotton, lemon [755]: bean [590]: pea [592]	many plants [589]: alfalfa, cotton, sugar beet [595]: cotton [755]: bean; $(EtO)_2P(S)SH$, $(EtO)_2P(S)OH$, $(EtO)_2P(O)OH$, H_3PO_4, unknown (maybe de-ethylated deriv.) [590]; pea [592]	cotton; $(EtO)_2P(S)SCH_2S(O)Et$, $(EtO)_2P(S)SCH_2S(O)_2Et$, $(EtO)_2P(O)SCH_2S(O)Et$, $(EtO)_2P(O)SCH_2S(O_2)Et$ [589]: pea; $(EtO)_2SP(S)SCH_2S(O)Et$, $(EtO)_2P(S)SCH_2S(O_2)Et$ [589]: alfalfa, cotton, lemon; as above on cotton [755]: bean; as above on cotton [590]
25	$(EtO)_2P(S)SC_2H_4SEt$ Disyston, Dithiodemeton, Ekatine	cotton [657]: alfalfa, cotton, sugar beet [595]: alfalfa, bean, cotton, lemon [755]: pineapple [558]	cotton [657]: alfalfa, cotton, sugar beet [595]: alfalfa, cotton [755]: cotton; diethyl phosphoric acids?, H_3PO_4?, phospholipids [755]: cotton, tomato and 10 other plants [559]	alfalfa, bean, cotton, lemon; $(EtO)_2P(S)SC_2H_4S(O)Et$, $(EtO)_2P(S)SC_2H_4S(O_2)Et$, $(EtO)_2P(O)SC_2H_4S(O)Et$, $(EtO)_2P(O)SC_2H_4S(O_2)Et$ [755]: cotton, tomato and 10 other plants; as above [559]: cotton; $(EtO)_2P(S)SC_2H_4S(O)Et$, $(EtO)_2P(S)SC_2H_4S(O_2)Et$ [754]

TABLE V (cont'd)

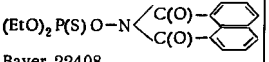
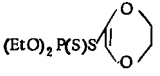
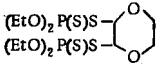
No.	Structure and name	Absorption and translocation	Hydrolysis products	Non-hydrolysed metabolites
26	$(EtO)_2P(S)SP(S)(OEt)_2$? impurity in Delnav	bean, cotton, tomato [749]	bean, cabbage, cotton, tomato [749]	bean, cabbage; more polar derivatives, possibly phosphorothiolates [749]
27	$(EtO)_2P(S)OPh-NO_2-4$ Parathion	many plants [574]: apple [581]	many plants [574]: grape and lemon leaf juice [574]	
28	$EtOP(S)(OPh-NO_2-4)_2$ impurity in Parathion	plants [574]	plants [574]	
29	$(EtO)_2P(S)OPh-S(O)Me-4$ Bayer 25141	cotton [657]	cotton [657]	cotton; $(EtO)_2P(S)OPh-S(O_2)Me-4$, $(EtO)_2P(S)OPh-SMe-4$ (trace), $(EtO)(EtS)P(O)OPh-S(O)Me-4$ (major), $(EtO)(EtS)P(O)OPh-S(O_2)Me-4$ [657]
30	 Bayer 22408	cotton [726]	cotton: (EtO)(HO)P(O)O-naphthalimido?, H_3PO_4 incorporated into plant products? [726]	cotton: $(EtO)_2P(O)O$-naphthalimido [726]
31	 impurity in Delnav	bean, cotton, tomato [749]	bean, cabbage, cotton, tomato [749]	bean, cabbage; more polar derivative, probably $(EtO)_2P(O)S$-p-dioxene-2 [749]
32	 Delnav-studies on separate and combined cis and trans isomers	bean, cotton, tomato [749]	bean, cabbage, cotton, tomato [749]	bean, cabbage; more polar derivatives, more active antiChE agents, possibly phosphorothiolates [749]
33	$EtOP(O)(NMe_2)_2$	turnip [620]	turnip [620]	turnip; $EtOP(O)(NMe_2)(NHMe)$? $EtOP(O)(NHMe)_2$? [620]
34	$MeHNP(O)(NMe_2)_2$	turnip [620]	turnip [620]	turnip; $(MeHN)_2P(O)NMe_2$? [620]
35	i-PrHNP(O)$(NMe_2)_2$	turnip [620]	turnip [620]	turnip; i-PrHNP(O)(NHMe)(NMe_2)? [620]

TABLE V (cont'd)

No.	Structure and name	Absorption and translocation	Hydrolysis products	Non-hydrolysed metabolites
36	n-BuHNP(O)$(NMe_2)_2$	turnip [620]	turnip [620]	turnip; n-BuHNP(O)(NHMe)(NMe_2)?, n-BuHNP(O)$(NHMe)_2$? [620]
37	$(Me_2N)_3P(O)$ impurity in Schradan	bean [604]; turnip [620]; sugar beet, strawberry [618]	bean [604]; turnip [620]; sugar beet, strawberry [618]; plants [616]	bean; more and less polar derivative(s), some containing organically bound formaldehyde [604]: turnip; $(Me_2N)_2P(O)NHMe$? [620]: sugar beet; $(Me_2N)_2P(O)NMe\cdot CH_2OH$? [618]: plants; unidentified intermediate [616]
38	$(Me_2N)_2P(O)F$ Dimefox, Hanane	pea [604]: bean [751]	pea [604]	pea: less and probably also more polar derivative(s), some containing organically bound formaldehyde and antiChE activity [604]
39	(MeHN)$(Me_2N)P(O)OP(O)(NMe_2)_2$ demethylated Schradan		turnip [620]	
40	$(Me_2N)_2P(O)OP(O)(NMe_2)_2$ and $(Me_2N)_2P(O)OP(O)NMe_2$ $(Me_2N)_2P(O)O$ Schradan or OMPA, technical	brussel sprout, hop, sugar beet, strawberry [617]	brussel sprout, hop, sugar beet, strawberry [617]	
41	$(Me_2N)_2P(O)OP(O)(NMe_2)_2$ Schradan or OMPA	sugar beet, strawberry [618]: bean, cabbage, hop, pea, strawberry [609] [750]: groundnut [627]: bean [756] [629] [626]: lemon, orange [624]: borage, mustard [614]: apple, bean, chrysanthemum, coleus [608] [752]: cotton [625]	clover, turnip [620]: sugar beet, strawberry [618]: plants [616]: bean [751] [629] [626]: groundnut [627]: lemon, orange [624]: borage, mustard [614]: apple, bean, chrysanthemum, coleus [608] [752]: plants; $(Me_2N)_2P(O)OH$, $(Me_2N)(Me_2NO)P(O)OH$? plus non-chloroform extractibles [620]: cotton, $(Me_2N)_2P(O)OH$?, H_3PO_4? [625]: many plants; $(Me_2N)_2P(O)OH$? [621]	plants; general reviews [414, 622]: bean; unidentified plant metabolite(s) [604]: bean, brussel sprout, clover, turnip; (MeHN)$(Me_2N)P(O)OP(O)(NMe_2)_2$ [620]: clover; (MeHN)$(Me_2N)P(O)OP(O)(NMe_2)$ plus antiChE agents [620]: plants; $(Me_2NO)(Me_2N)P(O)OP(O)(NMe_2)_2$, $(HOCH_2\cdot MeN)(Me_2N)P(O)OP(O)-N(Me_2)_2$, (MeHN)$(Me_2N)P(O)OP(O)-(NMe_2)_2$ [620]: plants; no non-hydrolysed intermediates [616]: bean; antiChE agent(s) [629]

J. E. Casida. Table I in "Metabolism of organophosphate insecticides by plants: A review." p. 49-64 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay 5-9 December 1960".

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*) Some comparison with other ionizing radiation(s)

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