active Diazinon purified by washing with K$_2$CO$_3$ solution and acetone distribution. Details of the microapparatus employed are given. The product is identified by paper chromatography. The analogous active diethyl phosphate was prepared similarly from $^{32}$Cl$_2$. Active Diazinon was also prepared from the K enolate of the same 6-hydroxyxypirimidine and $^{32}$SCl(OEt), but was contaminated with ethyl bis (2-isopropyl-4-methyl-6-pyrimidyl) phthalate arising from $^{32}$SCl(OEt) present in the $^{32}$SCl(OEt).

(See 50: 17229g, 1950)


$^{32}$P is introduced into PSCl$_2$ by exchange at 150°C after 24 h by using H$_2$P$_2$O$_5$. The reaction is carried out in a Carbofuran tube. The tube is then cooled in CO$_2$ snow-acetone mixture. The PSCl$_2$ is distilled into a solution of 2-isopropyl-4-methyl-6-hydroxyxypirimidine in benzene with a special apparatus. The diethyl thionophosphate ester is prepared as previously described (CA 49: 147099c). (CA 61: 10306g, 1967)


Les auteurs décrivent une méthode de préparation d'esters complexes des acides phosphoriques et thionophosphoriques et son application à la préparation du diethylphosphate de 2-isopropyl-4-methyl-6 oxyypyrimidine et du diethyliodonophosphate de 2-isopropyl-4-methyl-6 oxyphosphiniques marqués avec $^{32}$P.

(A comprehensive abstract may be found in CA 50: 14769d, 1958) (Voir 548)

548 Vigne et al. 1957 - [742]


Dans un précédent mémoire (1) nous avons décrit une méthode de synthèse du $^{32}$P, diethyliodonophosphate de isopropyl-2-méthyl-4 hydroxypyrimidine, dans laquelle nous introduisons le phosphore marqué sous forme de PSCl$_2$ préparé à partir du phosphore d'origine radioactif. Cette technique faisant intervenir un certain nombre de réactions délicates à réaliser sur de très petits quantités de composés volatils et radioactifs, nous avons cherché à tourner la difficulté en étudiant une réaction d'échange. Notre nouvelle méthode permet de préparer rapidement et avec un rendement intéressant, de petites quantités de composés halogénés radioactifs du phosphore en réduisant au minimum les manipulations et les dangers de contaminations.

(3) Voir 547


Les auteurs, désirant en dresser des traces dans des substances alimentaires provenant d'animaux nourris avec des végétaux traités par cet insecticide, ont réalisé: 1. Une nouvelle méthode de synthèse de cette série chimique, avec du $^{32}$P. 5. Une technique de chromatographie de partition (chromatographie en phase mi-humide), ainsi qu'une série de méthodes sensibles de détection colorimétrique de ce composé. 3. L'isolation d'une quantité notable de l'insecticide chimiquement pur, ce qui a permis l'étude de l'activité anticholinestérasique qui s'est révélée importante. 4. L'application de ces deux techniques au dosage dans le lait d'animaux ayant reçu des doses considérables de cet insecticide. Toute vité métabolisé, le DTP n'est pratiquement pas retrouvé dans le sang, le lait et les fèces, et n'est présent qu'en quantités minimes dans l'urine de l'animal en expérience (chèvre).
Dime-thoate


Dime-thoate was superior to standard and other candidate insecticides against the pea aphid. Residues were determined for whole plants treated with 0.25 pound per acre. Studies with radioactive Dime-thoate on and in pea plants showed seven compounds, including Dime-thoate, its oxygen analogue, and five hydrolysis products with phosphoric acid predominating.


Dime-thoate O, O-dimethyl S-(N-methylcarbamoylmethyl) phosphorothioate is known to be effective as a systemic insecticide following foliar application. Analyses were made of surface and absorbed residues following foliar treatment of corn, cotton, peas, and potato plants with Dime-thoate. The insecticide was rapidly absorbed and decomposed both on the surface and inside the foliage by phosphorothioate oxidation and hydrolysis. Only trace amounts of Dime-thoate and its oxygen analogue were present 30 d after treatment. Of the five identified hydrolysis products, the predominant one from mature peas was phosphoric acid and from other plants used as seedlings was O, O-dimethyl S-carboxymethyl phosphorothioate on the surface and O-methyl O-hydroxyl S-(N-methylcarbamoylmethyl) phosphorothioate within the leaf tissue. Limited studies were also made on the persistence of the N-ethyl analogue of Dime-thoate. (auth.)

(An abstract of earlier work was published in Bull. ent. Soc. Amer., 5, 3 (1960) 84, abstr. 29, under "The metabolism and residues of the systemic insecticide Dime-thoate in plants")


Dime-thoate is active as a systemic insecticide for cattle. Three lactating cows were treated orally with the 14C-labelled compound and analysis of blood, tissue, excreta, and milk showed Dime-thoate to be rapidly metabolized and excreted. Twelve days after treatment, the insecticide was found in trace amounts only in the cow tissues. Hydrolysis of Dime-thoate by rats and cows occurred initially at the methyl-phosphate, phosphate-sulfur, sulfur-carbon, and particularly at the carbonyl-nitrogen bonds. Phosphorothioate oxidation occurred with certain of the hydrolysis products and was assumed to occur also with Dime-thoate. (auth.)


The metabolism of 14C-Dime-thoate was studied following oral and intramuscular administration (10 mg/kg) to cattle. By both routes high radioactivity was detected in the blood shortly after administration. The radioactivity, representing both total and organosoluble compounds, was observed earlier and dispersed faster in the intramuscular treatment. Chromatographic analyses of blood extracts indicated the presence of both Dime-thoate and unknowns, with the latter several times more toxic than the parent compound as determined by enzymatic analyses and bioassay. About 87 to 99% of the oral dose was eliminated in the urine at the end of 24 h. The same percentage of intramuscular dose was excreted after 9 h. The major metabolic products were dimethyl phosphate, dimethyl phosphorothioate, and several unknowns. Only 3.7 to 6% of the oral dose and about 1.1% of the intramuscular dose were eliminated in the faeces. Analyses of tissues from an orally treated calf showed only very low levels (0.02 to 0.07 µg/g) of organosoluble radioactive compounds present in the brain, liver, testes, and lungs. (auth.)

Dipterces


Details are given of the preparation of 14C-labelled Bayer L13/59 (dimethyl 2,2,2-trichloro-1-hydroxyethyl-phosphonate from radioactive red phosphorus, and of labelled DDVP (dimethyl 2,2-dichlorovinyl phosphate) by dehydrochlorination of L13/59, and also of studies of their absorption by and translocation in last-instar nymphs of Periplaneta americana (L.). The compounds were applied in solution in ethanol to the dorsal cervical membranes, and both were readily absorbed through it. In the case of L13/59, the haemolymph and all tissues became radioactive. After 20 h, most of the internal radioactivity was in the gut, though some remained in all tissues examined, and much activity remained external. The haemolymph of the cockroaches treated with DDVP only slightly so. After 2 h, much of it was in the fat-body and only a small amount of radioactivity was probably attributed to the haemolymph and the gut. No significant radioactivity was detected in 20 h after treatment. (RAE-B 44)


The insecticide, called Bayer L13/59, was selected for selective toxicity. The LD50 values of certain phosphorus compounds having the same activity appeared to be caused by toxicity. Such relatively low, reliable data are discussed. Data are given on cockroaches, flies, and insects. (BA 31: 2969)


The synthesis and characterization of 14C-labelled 1,2,2-trichloro-1-hydroxyethyl-phosphonates and anticholinesterase activity was the most selectively toxic to houseflies than other phosphorus-carbon bond, and possibly, lindane appeared to be a major factor. (auth.)


Dipterex or O, O-dimethyl 1-hydroxyethyl phosphorothioate was synthesized and purified from diethyl DL-2-thiophosphate. The phosphorus-carbon bond was rapidly degraded to DDVP. The half-life of DDVP at pH 4.5 was about 0.9 h. The diethyl 2-thiophosphate decomposed to DDVP from total 5% DDVP, and the single phosgene is sensitive to in vivo degradation of DDVP in houseflies. (auth.)


Radioautographs revealed that the radioactive copper from the soil to the entire plant. The incrustable quantity in the green manure, roots of the crop, was the control. (auth.)


The sites of oxidative metabolism of 14C-labelled organophosphorus in several plant species using a 14C-labeled.
the cockroaches treated with DDVP did not become demonstrably radioactive, and many tissues became only slightly so. After 2 h, much of the radioactivity was concentrated in the brain. After 22 h, most of it was in the fat-body and only a small amount in the gut. The failure to detect radioactivity in the hemolymph was probably attributable to the low specific activity of DDVP, the small amounts applied in view of its high toxicity, and deposition in the tissues. No radioactivity could be removed from outside two hours after treatment. (RAE-8; 22-3, 1969)


The insecticide, called Bayer L13/59, and its derivatives were investigated with P-32 as to metabolism and selectivity. The LD50 values in mm, flies, cockroaches, cabbage worms and pea aphids varied widely between compounds and species; the aceyl form was generally least and the vinyl most toxic. Antinsecte activity appeared to be caused by dimethyl phosphorylation of enzymatically active sites. Mammalian toxicity was relatively low. Relations of the latter two observations to chemical structure and mechanisms are discussed. Data are given on detoxification, hydrolysis rates, volatility, and tissue distribution in insects and plants. (RA 31; 28099, 1957)


The synthesis and characterization of radioactive (P32-) Dipexen and bus tone are described. Several Q O-dialkyl 2,2,2-trichloro-1-acyloxyethyl phosphonates and related derivatives were compared as to toxicity and anticholinesterase activity. Q O-dimethyl 2,2,2-trichloro-1-n-butyloxyethyl phosphate was the most selectively toxic to houseflies of all the phosphates studied. In vivo and in vitro metabolism studies with insects and rats showed that this phosphate was hydrolyzed at the acyl group, the phosphor-carbon bond, and possibly the phosphor-oxygen-methyl bond. The initial site of in vivo hydrolysis appeared to be a major factor in the selective toxicity of this compound.


Dipterex or Q, O-dimethyl 1-hydroxy-2,2,2-trichloroethyl phosphate under mildly alkaline conditions is rapidly degraded to DDVP. The half-life values for this reaction are: pH 8.0 - 63 min, pH 7-30 min, and pH 6.0 - 89 min. The rate of reaction is very slow at pH 5.4. The in vitro inhibition of housefly head cholinesterase by 10^-5 M Dipterex showed marked pH dependency and ranged from 11% at pH 5.4 to 100% at pH 8.0, thus clearly demonstrating that DDVP formation is necessary for in vitro cholinesterase inhibition. In vivo studies of the mode of action of Dipterex showed that the rate of knockdown of houseflies feeding on Dipterex-treated moist sugar bait was much more rapid at pH 7.0 than pH 5.4, this, together with the 4-7-fold greater toxicity of DDVP over Dipterex and the isolation of about 10% of P-32 DDVP from the total P-32 metabolites in Dipterex-poisoned houseflies, strongly indicates that DDVP is responsible for the in vivo toxic action of Dipterex.

Di-Syton


Radiochromatographs revealed that the radioactive sulfur in S-35 tagged Bayer 10639 (Di-Syton) is translocated from the soil through the entire pineapple plant. Absorption is greatest in the roots and decreases to barely discernible quantity in the green half-developed fruit. Bioassays revealed that only in the region of greatest absorption, the roots, was the concentration of Bayer 10639 high enough to be toxic to weevils. (Agrub.)


The rates of oxidative metabolism and of hydrolytic decomposition of Di-Syton, or Q,O-dieyyl 5-ethyl-2-thioethyl phosphodiocetate (formerly called Bayer 10639) were measured at various temperatures and in several plant species using a 35S-radiotracer. The rates of oxidation of the Di-Syton metabolites in isolated
cotton leaves were accelerated by increased temperatures between 37° and 100°F, and from the
Arabian energy of activation 10300 cal per mole it was determined that the rate of oxidation of
Di-Syton sulfoxide increased about 1.9 times for each 10°C rise in temperature. Metabolism of Di-Syton
sulfoxide and hydrolytic decomposition of the toxic products occurred from 2 to 3 times as fast in cotton
leaves at 70°F as in cotton leaves. The rates in a number of other plants studied appeared to be intermediate
between those in tomato and cotton. (auth.)

(See earlier report by Metcalfe, Winton and Reynolds "Comparative rates of metabolism of Di-Syton at
various temperatures and in various species of plants" in Bull. ent. Soc. Amer. 3, 3 (1957) 23, abstr. 4)

Reynolds, H. T., Metcalfe, R. L., Winton, M. EFFICIENCY OF PLANT UPTAKE OF DI-SYTON FOLLOWING
VARIOUS METHODS OF TREATMENT. Bull. ent. Soc. Amer. 5, 3 (1957) 23, abstr. 4.

Using 14C-Di-Syton, C-2,4-diethyl s-ethyl-2-mercaptoethylphosphorothioate the efficiency of plant
uptake was measured after soil treatment with various methods of side dressings. The theoretical and
practical applications of this work will be discussed.

Guthion (Gusathion)

ÜBER DAS VERHALTEN DES INSEKTIZIDS GUSATHION BEI BAUMWOLLPFLANZEN UND DAS DAS
RÜCKSTANDSPROBLEM BEI BAUMWOLLSAMEN (Studies, by means of 32P-labelled
compounds, of the behaviour of the insecticide Gathion in cotton plants and of the subsequent residue
Braunschweig 1960. 1645-6. (In German)

After spraying the plants at intervals of 4 days, and by means of paper chromatography and autoradiography,
unchanged Gathion was found on the leaves plus two lipophilic metabolites and two other fractions. Seed
analysis and plant data indicate that Gathion is unable to diffuse through the capsule into the seed, nor
can it persist even from the leaf into the sap.

Tietz, H., Metcalfe, R. L., Fukuto, T. R. DAS VERHALTEN DES INSEKTIZIDS "GUSATHION" AUF BAUM-
WOLLPFLANZEN UND DAS RÜCKSTANDSPROBLEM BEI BAUMWOLLSAMEN (Action of the insecticide
"Gathion" on cotton plants, and the problem of residues in cotton seed). Höschner, Wirt. 10 (1957)

"Gathion" has proved effective against such cotton pests as Anthomonas grandis, Aphis gossypii,
Temesarya bimaculata, Alabama apticinus and Thrips spp. In the present studies it was labelled with
32P, and details of concentration and frequency of spraying are given. Leaves were analysed at different
intervals by means of microchemical methods and paper chromatography. Apart from radioactive hydrolys is,
products, 32P was recovered from the assimilation products of the plant as radioactive phospholipids. Seeds
which were still immature at the time of spraying contained much more 32P than mature ones, and much
higher quantities of 32P-labelled phosphate could also be precipitated from their oil. No seed contained
any traces of radioactivity in their oil after phosphate precipitation. No residues were found in the press
cakes. "Gathion" did not have any systemic effect.

Malathion

Darrow, D. L., Flapp, F. W. STUDIES ON RESISTANCE TO MALATHION IN THE MOSQUITO, CULEX

An investigation was made on the extent of cross-resistance to other insecticides in a Malathion-resistant
strain, and on the rate and nature of the detoxication of Malathion by larvae of a resistant and of a sus-
cceptible strain of Culex tarsalis. 32P-labelled samples of Malathion and Acetone were used. A colony of
Culex tarsalis Coq., 60 times resistant to Malathion was found to be resistant to Malathion (C[1,2-bis
(ethylenedioxy)ethyli] 2,4-diethyl phosphorothioate), and the diethyl homologue of Malathion (C[1,2-
bis(ethylenedioxy)ethyli] 2,4-diethyl phosphorothioate), although to a lesser degree. slight resistance to
Co-Ra25O[3,4-(1-chloro-4-methylphenyl)phosphorothioate] was also observed, but no
resistance was found to any other of a series of 14 organophosphor insecticides. Two-to-three-fold resist-
ance to DDT and Dieldrin was also found. Larvae of the resistant and a susceptible colony degraded
Malathion at about the same rate, and the larvae, largely through the formation of carboxylic acid
derivatives.


The mechanism by which it-per-

ceases the subsequent toxicity of the rat and dog EPN resulted in the formation of the metabolite in urine was not.

Knepper, H. R., O'Brien, R. D. Ent. Soc. Amer. 4, 3 (1959) 6

p25-labelled Malathion of very limited solubility and the water soluble metabolite. Considerable variation in metabolic
products found.

Knepper, H. R., O'Brien, R. D. STUDY OF MALATHION IN INSECTS

An attempt has been made to study its metabolism by using special techniques,

Knag, J. B., O'Brien, R. D. LAYING EGG, WHITE MOUSE

The fate of 32P-labelled Malathion is in the white mouse a few hours after the injection of the insecticide.

March, R. B., Fukuto, T. R., Metcalfe, R. L. LAYING EGG, WHITE MOUSE

The fate of 32P-labelled Malathion is in the white mouse a few hours after the injection of the insecticide.

Mengle, D. C., Casta, J. B., AND METHYL PARATHION IN

Bull. ent. Soc. Amer. 5, 3 (1957)

The rate of penetration, hydrolysis in one normal and two resistant

Seeman, F. W., O'Brien, R. D. MODIFICATION BY EPN. J. agric. Food Chem. 2, 3 (1954)

Homogenates of 11 rat tissues with

main hydrolysis occurred at the time of the formation and the movement of Malathion. Metabolism of EPN and Malathion in vivo in the body, but to a greater degree.

A complete description of the metabolic products is described in detail, also

The mechanism by which pre-treatment with EPN (O-ethyl O-p-nitrophenyl phenylphosphonodithioate) increases the subsequent toxicity of Malathion was investigated. 32P-labelled Malathion was used. In both the rat and dog EPN resulted in a masked shift in the initial detoxification site of the Malathion molecule from the carboxester to the thiophosphate bond. The percentage of the administered Malathion excreted as metabolites in urine was increased by EPN in the dog but unchanged in the rat. Malathion levels in rat tissues were increased by EPN, whereas Malathion levels in rat blood were reduced. Potentiation appears to result from an increased persistence rather than an increased concentration of Malathion in the tissues. 664

Kneger, H. R., O'Brien, R. D. METABOLISM OF MALATHION BY SEVERAL SPECIES OF INSECTS. Bull. ent. Soc. Amer. 4, 3 (1959) 84, abstr. 52.

p32-labelled Malathion of very high specific activity was topically applied to several species of insects, and the water-soluble metabolites extracted and identified by means of ion-exchange chromatography. Considerable variation in metabolism was noted with as many as 9 or more water-soluble degradation products found. 665


An attempt has been made to account for the selective toxicity of Malathion on the basis of differences in its metabolism by various species. Eleven metabolites were found in the German cockroach (Blatta germanica (L.)), and American cockroach (Periplaneta americana (L.)), and housefly (Musca domestica L.), and of these, Malathion was more toxic to each than to the insect and Malathion production was correspondingly lower; these effects account satisfactorily for the low toxicity of Malathion to the housefly. The low toxicity of topically applied Malathion to the German cockroach is attributable to poor penetration through integument. Technical steps in the preparation of p32-labelled Malathion are discussed. 666


The fate of p32-labelled Malathion has been extensively studied in the laying hen and, for comparative purposes, in the white mouse and in Periplaneta americana L. The experiments also included preparation of expected metabolites of Malathion and tests of their toxicity to various arthropods and their activity in inhibiting cholinesterase of the housefly (Musca domestica L.). The metabolism of Malathion in the cockroach is apparently less extensive and complex than it is in warm-blooded animals. The less effective metabolism in the insect may explain why Malathion is much more toxic to insects than to warm-blooded animals, in which most of the rapidly formed metabolites are apparently of a low order of toxicity. (from auth. summary) 667


The rate of penetration, hydrolysis and phosphorothionate oxidation was studied in vivo for the insecticides in one normal and three resistant strains. An attempt was made to correlate the degree of resistance with the rate of insecticide metabolism and the extent of in vivo cholinesterase depression. 668


Homogenates of 11 rat tissues metabolised Malathion at comparable rates, and to similar metabolites. The main hydrolysis occurred at the carboxyester linkage. The hydrolysis at this linkage, the over-all hydrolysis, and the formation of Malathion by various tissues in vitro were all inhibited by EPN in vivo. The synergism of EPN and Malathion in vivo is therefore probably not attributable to an increased level of Malathion in the body, but to a greater persistence of Malathion and Malathion in the tissues. The techiques used are described in some detail, also the synthesis of the p32-labelled Malathion used. 669

A study on the translocation of radioactive Malathion and methyl Parathion.

Parathion


In laboratory tests, rumen fluid from a cow hydrolyzed 18 organophosphorus insecticides to varying degrees. Malathion and TEPP (trimethyl pyrophosphate) were the most susceptible. Oxidation reactions were of much less importance than reduction reactions in metabolizing the compounds, and phosphorothioic acids were hydrolyzed much more rapidly than phosphates. The rate of reduction of radioactive Parathion in the rumen fluid of a cow that ingested it was similar to that in vitro. Parathion, Paraoxon, and their amino derivatives (O-D-tolyl- p-amino phenyl phosphorothionate and phosphates) were found circulating in the blood of the animal and were excreted in small amounts in the milk. Amino-Parathion constituted a major excretory metabolite of Parathion, together with diethyl phosphoric and phosphorothioic acids. The toxicological significance of these findings is discussed in relation to the toxicity of the various derivatives. Two amino compounds are much less toxic to houseflies (Musca domestica L.) and rats than Parathion and Paraoxon. (from auth. summary)


P32-labeled Parathion (I) and bis (p-nitrophenyl) ethyl thiophosphate (II) and similarly P32-labeled specimens were used for stability studies on 19 dusts. In covered dishes in the dark at 16-24° the loss of P is more rapid from I than from II (curves shown). At 40% in 100 h the specimen lost over 50% of its P content, while III lost that much only in 650 h. At lower temperatures the durability is much higher. Thus the disappearance of insecticidal action 1-2 d after field spraying is not mere evaporation. Similar tests under sunlight (temperature below 37°C) show a rapid loss of P with some 50% being lost after 1.5 h exposure of I, the rest being lost in 100 h. In diffuse sunlight some 50% of I occurred in 20 h; this is comparable to loss of activity from 50% elimination of I. The loss of P is much slower in sunlight than that of II in 70 h a 40% loss occurs. The process appears to be a complex photochemical reaction. Conclusion: fruit surface residues of I after 4 d of weather exposure should not exceed 0.25 mg per kg (apples) (CA 46: 9009d, 1954)


P32-labeled specimens of (OC3H7)2Po(C6H5)NO3, and Et-OPS (OC3H7)2N3 were used in 19 dusts which were applied to male and female specimens of the insects. Females were generally more resistant to both insecticides than the males. A direct relation was found between the amount of P which penetrated the insect body and the degree of poisoning, within each experimental group. Death occurs with lower level of the di-ET derivative than mono-ET derivative, but this is caused not by a mere difference of diffusion, since in dead specimens the difference in permeability disappears between females and males. Chrysomelid plants were allowed to absorb through the roots aqueous emulsion of the di-ET derivative (0.25 to 0.2%) and the penetration to the leaves was studied radiometrically. A spraying with even 0.2% emulsion failed to give complete control of Anthrenum predae although the amount of the insecticide which penetrated the plant mass reached 0.003% of the green mass at room temperature. This corresponds to 20-30 mg/kg. At lower temperature, when this value reached 60 mg/kg a considerable degree of control was attained and the insects contained up to 22 mg/kg of the ET derivative. The penetration into chrysomelid was substantially lower that found in beetles. However, on cabbage cultures no control was achieved by this method against bresipta brassicae, although withering of leaves was observed at 0.05% concentration of the emulsion, or higher. In cabbages and chrysomelid extracts considerable hydrolysis of the insecticide took place and after 30 d only the hydrolysis product remained; this process is accelerated by sunlight. Dusting with 1% dust on shaded kidney beans showed 42% hydrolysis after 16 d; in sunlight almost all was hydrolyzed in 4 d.

Gar, K.A., Kiplanl, R.Y. RESISTANCE AND RESIDUES OF PHOSPHORUS ON THE PEACEFUL USES OF ATOMIC ENERGY. THE authors summarize Russian investigations of P32- and P32-labeled Parathion, NEU-101 and O-ethyl P32-O-difluor- or O32-O-dithio-S Glu 2-diarsine of NEU-101 and Carbacho was reported. Malathion and Malathion were about equal. The latter two were resistant and methyl Parathion was resistant. Paper chromatographic studies revealed similar decomposition and toxicity of the insecticide by P32 on plants shortly before harvest.

Hein, R.E., McFarland, R.H. SOC. 74 (1952) 1856-7.

The insecticide was labeled with P32 and Synthesis proceeded via O32-O-glucuronate are described.


The absorption and distribution of and hibernating hamsters. Although the animals at lowered temperature Cumulative dosage effects were observed and hibernating animals are described.

Jensen, J.O., Durham, W.P. 1958. RADIOACTIVE ISOTOPE TECHNIQUES IN AGRONOMY. A study on the fate of the radioactive Parathion has been made. Evidence for a sulfur-bearing portion of the degradation products is rapid and is absent when precipitated with ammonium molybdate.


A very brief description of the method of radioactive isotope obtained was 200 μCi/kg.


Lichtenstein, E.P. MOVEMENT CONDITIONS. J. econ. Ent.
almost all was hydrolyzed in 4 d. On wheat the process takes but 2 d. Thus Parathion is not truly a systemic insecticide, owing to its poor penetration and stability in the plant. (CA 48: 9000g, 1964)


The authors summarize Russian research with several radioactive organic phosphorus insecticides including: 32P- and 35S-labelled Parathion, methyl Parathion or O,O-dimethyl O-p-nitrophenyl phosphorothionate, NU-41, O,O-diethyl O-p-di-(p-nitrophenyl)-dithiophosphate, NU-41, O,O-diethyl O-p-di-(p-nitrophenyl)-dithiophosphate, O,O-diethyl S-(1,2-dicarbethoxyethyl)dithiophosphate. The photochemical stability of formulations of NU-101 and Carbophos was greater than that of Parathion and Malathion. Formulations of Parathion and Malathion were about equal in their stability to heat, and NU-101 and Carbophos were approximately the same; the latter two were slightly more stable than the former. The plant systemic properties of Parathion and methyl Parathion were slight; hydrolysis of both compounds proceeds rapidly inside plants. Paper chromatographic studies of alkaline hydrolysates and extracts from plants treated with methyl Parathion revealed similar decomposition products; there was no evidence of oxidation and upgrading of toxicity of the insecticide by plants. It was recommended that several of these insecticides could be used on plants shortly before harvesting.


The insecticide was labelled with both 32P and 35S. Phosphorus trichloride was used as starting material. Synthesis progressed via O,O-diethyl-chlorothionophosphate. The various steps in the experimental procedure are described.

576 Jäger, A. VEREINIGTE MIT radioaktivem 32P-0,0-Diethyl-0, p-NITROFENYL-MONOTHIO-
PHOSPHAT AM GOLDHAMSTER (Mesocricetus auratus Watten). (Experiments on the golden hamster (Mesocricetus auratus Watten.) with radioactive 32P-labelled O,O-diethyl O-p-nitrophenyl-thionophosphate) Naturwissenschaften 40 (1953) 594-5. (In German)

The absorption and distribution of 32P-labelled Parathion or its breakdown products were studied in active and hibernating hamsters. Artificial "hibernation" was obtained by injecting insulin and maintaining the animals at lowered temperatures. The lethal dose in active animals was 7-9 mg/kg of body weight. Cumulative dosage effects were observed. The symptoms and characteristics of hibernation action in active and hibernating animals are described.


A study on the fate of Parathion in rabbits treated dermally and intravenously with radioactive 32P-labelled Parathion has been made. Evidence was obtained that there is very little accumulation of Parathion or a sulfur-bearing portion of the molecule in the blood, organs, or tissues. The compound or sulfur-containing degradation products are rapidly excreted in the urine. The excreted moiety appears to be the inorganic residue of Parathion and is absorbed by anion exchange resins, from which it can be regenerated and precipitated by ammonium molybdate. (auth. summary)


A very brief description of the steps in the preparation of 32P-labelled Parathion is given. The specific activity obtained was 220 µc/mM.


In 1954 a Miami silt loam and a muck soil were treated with Aldrin, Lindane and DDT. Seventeen months later, tilling of the soil showed no noticeable differences in the distribution between individual insecticides, in a vertical sense; Lindane was found to be unequally distributed in a horizontal direction. Distribution was again tested three years after treatment. Experiments, conducted under laboratory conditions, showed that Lindane was leached to some extent from a treated soil into an untreated one. The leaching was most noticeable in the surface sand and least noticeable in muck soil. Under non-leaching conditions, Lindane also moved into the untreated layer, but more was retained in a muck soil than in a surface sand. When radioactive Paraathion (32P) was used, it was found that during a period of 6 days Paraathion moved upwards, downwards and sideways as well. The results obtained seem to indicate that the movement of Paraathion is more rapid in a surface sand than in a muck soil, as the latter retains the insecticide to a greater extent. Preliminary experiments with Aldrin under non-leaching conditions indicate movement of this insecticide to a considerable extent. (from auth. abstr.)

Earlier work was reported as abstract in J. ent. Soc. Amer. 53: 3 (1957) 42, abstr. 39.

Lockau, S., Lüdtke, M., Weygand, E. DARSTELLUNG VON RADIOAKTIVEM DIÄTHYL-0-NITROPHENYL-MONOTHIOPHOSPHAT UND BEISPIELE SEINER BIOLOGISCHEN ANWENDUNG (Preparation of radioactive diethyl-0-nitrophenyl-monothiophosphate, with examples of its biological applications) Naturwissenschaften 38, 16 (1951) 355. (In German)

Paraathion was labelled with 32P and used for determining its uptake by insects, and its ability to penetrate into plants. Cuticular applications were made with a water emulsion of the compound, and amounts of Paraathion sufficient to produce mortality were determined with the American cockroach, Periplaneta americana (L.) and Drosophila melanogaster. The penetration of a water emulsion of the radioactive compound into apples was also studied.


The compound is synthesized from red radioactive phosphorus via 32P-labelled phosphorus pentachloride, 32P-labelled phosphorus sulphochloride and 32P-dichloro-0-nitrophenyl-thiophosphoric acid. After application to the pronotum, this radioactive phosphoric acid enters penetrate into the body of Periplaneta americana L. and leads to the symptoms typical for Paraathion poisoning. The compound or its 32P-containing metabolites are distributed differently in the various organs. The head is highly radioactive, probably due to the lipid-soluble components of the cerebral ganglion. The high radioactivity of the intestine may in part be explained by its excretory function. The total average radiation for the whole insect corresponds to 3.07 y of the compound. The lethal dose is below this value, since part of the poison, on penetration and distribution through the organism may be secreted in the fore-gut intestine, where it may be suffering breakdown or have been broken down previously.


32P-labelled Paraathion was applied locally to leaves of Ligustum ovalifolium Hasl. and Polyphyllum falcatum (L.) Diels, to twigs of various ages of Prunus cerasus, wild plums, peaches, pears, and to stored apples. Paraathion was used in a concentration of 0.05% in distilled water. Its absorption and conductivity or that of its decomposition products in these plant tissues was studied by a G-M counter and autoradiography. The diffusion capacity in terms of 32P-labelled compounds was studied.


The author reviews his own and other work done in the field. The first part covers treatment of plants by E 605 (essentially dimetil-0-nitrophenyl-monothiophosphate, with the addition of a little Paraathion, i.e., O,O-diethyl-0-nitrophenyl-monothiophosphate) and by Paraathion, in order to test their distribution within the plant, and the terms of a possible "internal therapy" against pests from outside, as observed for some phosphoric acid ester. The second part is concerned with the uptake of E 605 and of Paraathion by animals. References are numerous but incomplete, i.e. the authors and year are quoted but not the source.

Mandelbaum, Ya. A., Vladimirov, T. PHOSPHORUS COMPOUNDS AND SULFUR. P. 45-66

Details are given of a study in which 32P was added to fishes (NISUP-101) were labelled with 32P.


Labelled Paraathion (8) was prepared by radiochemical purification of a previously reported compound from H2 32P10 and 32P10. The other was converted to 32P10-labeled 65% (ETOP, PSC) with which 32P10 was compared.

Sato, T., Tomizawa, C. CEREBRAL TECHNIQUE. RADIOACTIVE.


The fate of the labelled insecticide Paraathion in Periplaneta americana, and the...


Thimet is metabolized by plants and insects, and the insecticide for seed treatment of cotton. The radioactive sulfonyl methyl phosphorodithioate, dimethyl-0-sulfonyl methyl phenylcarbamate, (a carboxylic phosphorus) and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and 32P-labelled compounds and...


The oxidative and hydrolytic metabolism...

Details are given of a study in which Parathion and D-ethyl O-D-4-(nitrophenyl)thiophosphate (NUF 101) were labelled with $^{32}$P and $^{35}$S. (Technical details may be found in abstract CA 50: 1650f, 1956/57).


Labelled Parathion ($^{32}$P) was prepared for investigations of insect toxicology. The method used was a modification of a previously reported preparation (CA 46, 1310g). Quantitative yields of $^{32}$POC$_5$ were obtained from H$_2$PO$_4$ and PCl$_5$. The oxchloride gave $^{32}$PCl$_5$, when reduced over carbon granules at 1000øC; this was converted to $^{32}$P$_2$SCl$_2$ when heated in a sealed tube with sulphur. $^{32}$PCl$_5$ with NaOK gave $^{32}$P$_2$Cl$_5$, which with aqueous P$_2$O$_5$ gave P$_4$O$_6$ (on Cl$_2$) (CA 47: 2726, 1955).


The fate of the labelled insecticide was studied in the rice stem borer Chilo suppressalis (lepidoptera), Periplaneta americana, and the weevil Callosobruchus chinensis.


Thimet is metabolized by plants to form very potent anticholinesterase agents. When used as a systemic insecticide for seed treatment of cotton, the metabolites within the plant consist of O-D-ethyl thiophosphonothioate, O-D-ethyl O-D-thiophosphonothioate, and O-D-ethyl O-D-thiophosphoramidate. The last of these metabolites is the most active cholinesterase inhibitor and provides a method of residue analysis. Such analysis is based on chloroform extraction of $^{32}$P-labelled compounds and is made on various soluble, insoluble, hydrolyzed and oxidized fractions. Cotton seeds treated with Thimet on charcoal at concentrations as high as 32 pounds of Thimet per 100 pounds of seed showed less than 0.00 µm of Thimet or metabolites in the seeds maturing from the treated plants. The residual persistence following soil and foliage application was studied with 6 vegetable crops and radioactive Thimet. (from auth.)

590 Bowman, J. S., Casta, J. E. FURTHER STUDIES ON THE METABOLISM OF THIOMET BY PLANTS, INSECTS, AND MAMMALS. J. econ. Ent. 51, 6 (1958) 836-34.

The oxidative and hydrolytic metabolism of Thimet by plants, insects and mammals was further studied with chromatographic and radiotracers techniques. Bean plants, southern armyworm, Tobacco etch virus (Carmen), silkworm larvae, and a cow were utilized. The proportions of Thimet, oxidized derivatives, and hydrolysis products were determined with bean plants which had absorbed Thimet through their root, with armyworms which had fed on these plants, and with the feces of the armyworms. Armyworms were more efficient than bean plants in vivo in oxidation of the phosphorothioate group of Thimet and in hydrolysis of the oxidation products. With the mammals, the excreta products and tissue residues were investigated. Extreme difficulty was encountered in extraction of the radioactivity from the tissue of the treated rat and cow. (The Thimet had been synthesized with $^{32}$P). The relative insect and mammalian toxicity and stability to hydrolysis by alkali are reported for Thimet and its oxidation products. (from auth.)


$^{32}$P-labelled organothiophosphate insecticides were used throughout. The work was published in three articles.


Bibl. SYSTEMIC INSECTICIDES FOR THEOBROMA CACAO L. THEIR TRANSLLOCATION AND PERSISTENCE IN FOLIAGE AND RESIDUES IN CACAO BEANS. J. econ. Ent. 51, 6 (1958) 739-50.


Studies were conducted to determine the hydrolysis, oxidation, insecticidal efficiency, persistence, and degree of binding of Phorate, formerly designated as Thimet (O,O-diethyl S-(ethylthio)methyl phosphorodithioate) in three soils and quartz sand. Phorate applied as a soil treatment in the field was more available to cabbage and potatoes grown in a sandy loam soil than in a clay-loam soil as indicated by insect-control data and anticholinesterase assay. A measurement of $^{32}P$-labelled phosphate uptake by peas from three soils and quartz sand showed that the largest amounts of toxin were taken from quartz sand and followed by lesser amounts from a sandy loam, clay loam, and muck. In that order. Extraction, column chromatographic and partitioning techniques showed that soil applications of Phorate are partially oxidized, hydrolyzed, and bound to the soil. Chloroform extractions of radioactivity from the soils at 7, 14, and 28 days after treatment were identified as Phorate plus a mixture of the phosphorodithioate sulfide and the phosphorodithioate sulfone of Phorate. Only a very small amount of the radioactivity extracted from the soils could be identified as hydrolysis products. A large portion of the radioactivity remained bound to the soil and could not be identified. Radioactive Phorate added to quartz sand and was rapidly hydrolyzed, but no oxidation products were detected. A study of Phorate volatilization from the soils showed that within an hour after treatment the sandy soil, silts loam, and muck had lost 25%, 20%, and 16% of the radioactivity respectively. However, after this initial loss, very little or no volatilization occurred. Phorate was lost rapidly from quartz sand and a steel surface with less than 10% of the radioactivity remaining 24 h after treatment.

(H. L. W. Chapman and R. K. Getzinger, USDA.)

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Absorption of $^{32}P$-labelled Phorate from nutrient solution by cotton plants was linear through 72 h and proportional to the applied level. Subsequent uptake was inversely correlated with plant content. The absorption of inorganic phosphate was reduced by Phorate additions to the solution.

(This work was continued and published in J. econ. Ent. 54, 2 (1961) 379-82, and 54, 3, 411-3, as LABORATORY AND FIELD INVESTIGATIONS WITH PHORATE-TREATED COTTON SEEDS and PHORATE ACCUMULATION BY COTTON PLANTS AND RECOVERY FROM SOIL.)

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Hasklayo, J., Linequist, D. A., Davich, T. B. ABSORPTION OF PHORATE BY COTTON SEEDS. Bull. ent. Soc. Amer. 5, 3 (1959) 119, abstr. 84.

The uptake of $^{32}P$-labelled Phorate by cotton seeds, following seed treatment, was studied in the laboratory, greenhouse and field. Data were presented on the effect of removing cotton seed hulls prior to treatment and the effect of temperature on Phorate uptake by cotton seeds.

594


Tests have shown that systemic insecticides applied to the seeds of cotton, lucerne and sugar-beet at the time of sowing protected the seedling from attack by a wide range of insects. Studies with radioactive Bayer 16699, Thimet and Demeton-S showed that, after treatment, the cotyledons contained the highest concentrations of toxicant and that this was not translocated in substantial amounts to other plant parts. The toxicant therefore existed in the plants in a considerable concentration gradient, ranging from the highest value in the oldest leaves to the lowest in the youngest. Effective toxic concentration of the different insecticides is discussed, as applied to the various plants and their infesting insects.

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The synthesis, purification, and radioactive $^{32}P$-labelled phosphate in the growth of the rooster.
Phosphin

596
Gatterdam, P. E., Knack, J. B., Niedreimeier, R. P., Casida, J. E. METABOLISM AND RESIDUES OF PHOSDRIN INSECTICIDE PRED TO DAIRY CATTLE. Bull. ent. Soc. Amer. 9, 9 (1957) 31-38. Studies with 12 lactating cows were conducted to determine the toxicity and residues in the meat and milk resulting from 90 day feeding of 0, 1, 5, and 20 ppm of Phosdrin in the diet. Further metabolism studies were made with radioactive Phosdrin at 2 mg/kg in a single dose and 1 mg/kg daily for 12 d.

597
Gettin, L. M., Chapman, R. K., EFFECT OF SOILS UPON THE UPTAKE OF SYSTEMIC INSECTICIDES BY PLANTS. Bull. ent. Soc. Amer. 9, 2 (1959) 116-10. The effectiveness of insecticide applications to soil often depends upon soil conditions. Experiments were therefore conducted to determine 1) the effect of various soil types upon systemic insecticide absorption by plants from the soil, and 2) the characteristics of soil which bind the insecticides against the leaching action of water. The absorption of some systemic insecticides by peas from four soils and two sands was measured by aphid bioassay and anticholinesterase analysis. The pea aphid (Maccrotaphium plat (Walker)) was used in conjunction with Thimet® (O-Diethyl S-(ethylthio)methyl phosphorothioate), Schaben, Isolan® (dimethyl S-1-(2-hydroxy-3-methylpyrazolyl) carbamates), and Phosdrin® (1-methoxy carbonyloxy-1-propan-2-yl dimethyl phosphate, 90% technical). The binding of an insecticide in soil was studied by identifying radioactive Phosdrin through columns of soils. The amount of Phosdrin bound by the various soils correlated to a positive manner with the base exchange capacity, organic matter content and nitrogen content, but it was concluded that the organic matter content was primarily responsible for insecticide binding. Other chemical and physical properties of the soil did not correlate with the binding of Phosdrin.

598
Spencer, E. L., Robinson, J. R. METABOLISM OF THE SYSTEMIC INSECTICIDE O-DIMETHYL 1-CARBOMETHOXY-1-PROPYL-2-YL PHOSPHATE (PHOSDRIN) IN THE PEA PLANT. J. agric. Food Chem. 8, 4 (1960) 292-3. Phosphate-labeled Phosdrin and dimethyl phosphate-labeled Phosdrin were used in this study. It was undertaken to define the degradation mechanism of Phosdrin isomers in plants, because alkaline hydrolysis yields different degradation products. Two isomers were found to degrade in the same manner, but at different rates in pea plants. By administering one metabolite, Phosdrin acid, to plants, it was possible to recover a monohydroxy derivative. The enzymatic degradation of Phosdrin in pea plants differs from the alkaline hydrolysis in that at least two pathways are involved, the Pea isomer being dimethyl phosphate directly.

599
Hopkins, T. L. FUNCTIONS OF THE MADEIRA ROACH ALIMENTARY TRACT IN THE ABSORPTION, METABOLISM, AND EXCRETION OF O-DIMETHYL O-(2, 4, 5-TRICHLOROPHENYL) PHOSPHOROTHIOATE (SONNIEL). Dis. Abstr. 21, 3 (1960) 707-8. The role of the alimentary tract of the roach Leucophaea madiera (F.) in water and processes of absorption, transport, metabolism and excretion of sonninel was investigated together with the effect of the compound on the rate of the phosphorus-containing metabolites eliminated. The insectide was labelled with 32P.

600
Loudon, S. J. THE SYNTHESIS OF O-DIMETHYL TROLINE, ITS ABSORPTION, DISTRIBUTION, AND EXCRETION BY THE COCKROACH, LEUCOPHAE A MADIERA (F.), AND WHITE MOUSE, MUS MUSCLEUS. Dis. Abstr. 21, 5 (1960) 1601-2. The synthesis, purification, identification (by chromatographic analyses and the infra red) and the fate of O-Diethyl labelled troline in the organism are described. Oral and topical applications are considered.

601
Pirg, F. W., Casida, J. E. BOVINE METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. METABOLIC FATE OF O-DIMETHYL O-(2, 4, 5-TRICHLOROPHENYL) PHOSPHOROTHIOATE IN RATS AND A COW. J. agric. Food Chem. 9, 0 (1960) 682-7. O-Dimethyl O-(2, 4, 5-trichlorophenyl) phosphate is susceptible to hydrolysis at either the methylphosphate or phenylphosphatase bond. Both sites of hydrolysis have been demonstrated with alkali and bovine enzyme, and in vivo, houseflies, and cow. The oxygen analogue of this insecticide undergoes similar hydrolytic cleavage. The excretory metabolites of O-Dimethyl O-(2, 4, 5-trichlorophenyl)
phosphorolate and three derivatives were established for rats. A slower detoxification and excretion of the herbicide metabolites occurred with the cow compared to rats, but the same metabolic pathway was demonstrated for each. **P** was used for labelling.


The metabolism and excretion of **P**-labelled Dow ET-57 (O-dimethyl O-2,4,5-trichlorophenyl phosphorolate) in a Guernsey bull calf has been studied following its oral administration at the rate of 100 mg/kg. Analysis of the blood sampled at intervals and the quantitatively collected urine and faeces by radiochemical assay, partition coefficients, and paper chromatography demonstrated the efficient absorption, degradation, and excretion of the compound. Approximately 50% of the total dose was accounted for in the urine at 30 h and about 90% in the urine and faeces at the end of 10 d. Unchanged Dow ET-57 was present in the extracts of blood and faeces while only metabolites products were found in the urine.

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A number of compounds were tested against the "waxing fly", Hypoderma lineatum (VIII), and H. bovis (Deg.) in cattle as systemic insecticides, prior to 1945. Experiments with Dow ET-57 in 1955 showed it to cause a high mortality in the larvae of both species when they are encysted in the backs. There was no indication that ET-57, administered orally at 100 mg/kg affected the health of the cow or meat production. It was slightly toxic at 150 mg, but recovery was rapid. The meat of treated animals was eaten without ill effect. Two calves dosed with **P**-labelled ET-57 were found to contain 50 to 70 parts per million in the fat when slaughtered after 3 and 14 d, respectively. Limited tests with Bayer 21/199 [O, O-dimethyl O-3-chloro-4-methyl-7-carboxyphenoxyphosphate] showed that this compound also destroys Hypoderma larvae before they can damage the hide of the host and that, unlike ET-57, it does so when applied as a spray. It is concluded that both show promise for the control of Hypoderma but neither can be recommended until more complete toxicological information is available.

Schrödinger

Arthur, B. W., Cuesta, I. E. BIOLOGICAL AND CHEMICAL OXIDATION OF TETRAMETHYL PHOSPHOR-


Comparative radiotracer experiments were carried out on the chemical oxidation and metabolic behaviour of Dimexon [bis(dimethylamino)fluorophosphate oxide]. Schradan and hexamethyphosphonamide (containing **P**) in insects, mammals and plants. Their distribution and absorption is discussed. Within insects, plants and mammals investigated, each of the three compounds was metabolized to oxidized derivatives that decomposed on treatment with acid to yield formamidé. With all three compounds, one oxidative derivative was more and another less polar than the original phosphonamide. Except for the greater instability of Dimexon and its derivatives, the metabolic intermediates appeared to be similar to those of Schradan and hexamethyphosphonamide.

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Methods for the preparation of radioactive Schradan in solution, and the general experimental technique and procedure adopted throughout are described. This includes the methods for propagation of plant material for experimental use, and the application of the radioactive insecticide to leaves either by dipping or spraying. As account is given of the conditions under which the plants were kept, the procedure adopted at sampling involving the inclusion of the treated leaves, subdivision of the plant and preparation of samples for determination of "Schradan" and "Schradan equivalent" by liquid counting. The methods of compiling results to determine the distribution and status of the applied Schradan in or on the leaves at harvest, are outlined.

[Cf. II. "Evaporation and absorption," by Bennett and Thomas, 1954, and III. "Translocation and breakdown," by Thomas and Bennett, 1954]

Aqueous solutions of $^{32}$P-labelled compound were applied at concentrations between 0.06 and 0.095% usually, between 1 and 2 ml were given to each plant by spraying or dipping. The activity was always below 2.5 mc/ml. Differences in absorption are observed between plant species, upper and lower leaf surfaces, and the effects of some physical factors on the process are noted. The main translocation is upwards from treated leaves. Decomposition of the insecticide is more rapid in broad and runner beans than in chrysanthemum and Coleus.


The absorption, translocation and breakdown of Schradan in plants was studied by means of $^{32}$P-labelled Schradan. Maximum absorption by the leaves occurred if the leaves were treated when their carbohydrate content was low, but it was more important that the application should be followed by a period of active photosynthesis. The lower leaf surface in chrysanthemum was more absorptive than the upper surface. Translocation of Schradan from sprayed leaves was slow, and only a small amount was absorbed. Translocation was generally found to occur towards the younger leaves and to be closely associated with active physiological processes. Breakdown varied considerably between the plant species tested.


When $^{32}$P-labelled Schradan was sprayed on the leaves of apple stocks and seedlings, broad and runner beans, Coleus and chrysanthemum, some was absorbed, some evaporated and the rest remained for a considerable time on the leaf surface as a residue removable by aqueous leaching. Some breakdown of Schradan may occur within the cuticular layer. Comparisons of the absorption rates of upper and lower surfaces of leaves support the theory that absorption proceeds through the cuticle in preference to vapour phase entry through the stomata. Temperature and illumination were found to have important effects on absorption. Lower due to evaporation were lower than expected. Young leaves have been shown to be generally more absorptive than the older leaves. Comparisons have also been made of the absorption by different species to be interpreted cautiously. Absorption was found to take place rapidly through detached leaves, in which stomata are closed, and it was also absorbed by the upper and lower surfaces of Coleus leaves at equivalent rates, although the upper surface of this leaf has no stomata. Schradan was decomposed much more rapidly in the bean than in chrysanthemum and Coleus.

[cf. I. "Experimental techniques," by Barr et al. and III. "Translocation and breakdown," by Thomas and Bennett].


The toxicity of bis(4-dimethylamino) phosphonous anhydride-$^{32}$P was detected against Aphid fabae on broad beans, Myzus persicae on cabbage, and Acyrthosiphon piicris on peas with solutions equivalent to 10 mc/l. Arrays of radioactive solutions were made in a liquid-type counter after treating plant material with boiling NaOH solutions. The room, and to a lesser extent, the leaves of bean plants quickly absorbed $^{32}$P from culture solutions in concentrations which caused aphids to fall from the plant. Culture solutions increased in radioactivity; this indicates preferential absorption on nonradioactive $^{32}$P. Absorption of $^{32}$P was more rapid from sand than from soil with radioactivity being greater in top and bottom leaves. One concentration of 100 mg/kg plant tissue was lethal to aphids. Translocation of $^{32}$P was observed in leaves of the cabbage, pea, strawberry, hops, and, to a lesser extent, broad beans. Leaves of runners became radioactive after application of $^{32}$P to the leaf of the parent plant. Radioactive material was not given off by plants absorbing $^{32}$P through the root. The honey dew of aphids feeding on $^{32}$P-treated plants was radioactive. (CA 45: 354b, 1951)
A dose of 50 mg/kg of Schradan(NMe₂)₂PO.O.PO(NMe₂)₂, injected into rabbits, leads to death within a few hours with typical symptoms of acetylcholine poisoning (excessive salivation, fibrillary twitchings, etc.) as produced by fluorophosphonates and other anticholinesterases. However, when the action of this anticholinesterase is measured in vivo, surprisingly high concentrations are required to reduce by 50% inhibition, in contrast with other organic phosphorus compounds which are effective at concentrations of the order of 10⁻⁶ to 10⁻⁷ M. This apparent anomaly was investigated by comparing the effects of the anticholinesterase on rabbit blood cholinesterase activity in vitro and in vivo by means of ³²P-labelled anticholinesterase. The results can be explained by postulating the conversion of the anticholinesterase in vivo to some more active inhibitory compound, the liver being one place where this can occur. The formation of the half molecule, (NMe₂)₂PO(OH), is excluded as this is inactive.

A method is described for the conversion of radioactive phosphonic acid into phosphoryl chloride on a small scale, and thence through chlorohydridimethylenephosphonic oxide into bis(dimethylenephosphonic acid) (cf. preliminary note, Research, 52 (1940) 505). The labelled product is suitable for tracer work in plants (in which the compound acts as a systemic insecticide) and in animals (where it shows anticholinesterase activity). Preparation of the non-radioactive form on a larger scale is also described.

The possible presence of unchanged insecticide in the nectar of flowers and its subsequent appearance in honey was examined. An aqueous solution of "Schradan" containing ³²P-labelled insecticide and a wetter were sprayed on the leaves of white mustard plants (Sinapis alba). The sequence followed in spraying and collecting is described. Concentrations of unchanged Schradan in nectar were determined by radio-assay. Another test was made with borago (Borago officinalis) for Schradan content in nectar.

The reported low toxicity of Schradan to honey bees was confirmed. Using Schradan labelled with ³²P, it was shown that spray applications of this insecticide on mustard and borago plants does result in the contamination of nectar. A series of nectar samples taken over a 4-week period following spraying showed on radio-assay a progressive increase in total ³²P content and also in the amount of Schradan present in proportion to the decomposition products. The highest figure recorded for the Schradan content of nectar was 21 ppm. Tests on stability of Schradan in contact with the honey stomach of the bee and also in contact with the enzyme invertase, in vivo, showed that no appreciable breakdown occurred. Schradan, moreover, was stable in contact with honey over a period of 2.5 months. It is concluded that this systemic insecticide may appear in an unchanged form in the honey obtained from the nectar of plants which have been sprayed less than 4 weeks previously. (auth. summary)

The fate of some systemic insecticides in beehives, with p²³ as a trace element in them. The stability of the applied material may be measured by the bi(s(dimethylenephosphonic) oxide) same rate as the insecticides. The extracted honey was found by the absorption test in each compartment in a semi-permeable 

The systemic insecticide bifon, which was synthesized as ³²P-labelled by living plants, is described. No preparative details of the toxic product originally presented the product. By following the Schradan, it is shown that the compound acts as a systemic insecticide in plants and animals (where it shows anticholinesterase activity). Preparation of the non-radioactive form on a larger scale is also described.

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of bis(dimethylamino)phosphinic acid was used for preparing Schradian in the laboratory. Following the commercial method of preparation, commercial OMPA was shown to contain, in addition to octamethylphosphoramic acid, a comparable amount of trisphosphoric acid pentadimethylamide. This latter compound was apparently good as a systemic insecticide as the former but much less toxic to mammals. A separate synthesis of the trisphosphoric acid pentadimethylamide containing \( p^2 \) was carried out in order to study more thoroughly the behaviour of this compound in biological and analytical tests. A smaller amount of orthophosphoric acid trimethylamide and minor amounts of pentamethyldiamides of higher polyphosphoric and cyclic metaphosphoric acids were also found in the commercial material. A method of analysis for OMPA, based upon the various rates of alkaline hydrolysis and differences in the partition coefficients of the compounds listed above, was described.


The systemic insecticide bis(bis(dimethylamino)phosphinic acid) hydride (octamethylphosphoramic acid) was synthesized as \( p^2 \)-labelled OMPA. In order to study the chemical fate of the substance on its uptake by living plants, preparations of about 100 \( \mu \)g/gm were used in order to obtain the necessary sensitivity in analysis. No preparative details are given in this paper. Within 1 weeks of spraying only about 10% of the toxic product originally present absorbed by the plants remained unchanged; up to 50% is present as decompositions product. By following the fate of hexamethylphosphoramide it is possible to throw some light on the mechanism of decomposition in the plant. It is probably entirely different from that of intact hydrolysis.


Test plots of strawberries, sugar beets, hops, and Brussels sprouts were sprayed at various times from May to October with radioactive material containing approximately equal proportions of the systemic insecticide octamethylphosphoramic acid and its higher homologue, trisphosphoric acid pentadimethylamide. On analysing the sprayed crops at various times after spraying, it was found that the concentration of both compounds in the plants fell at the same rate, and that this rate varied little among the plant species. The rate of lowering of concentration was slowest as the year progressed from May to September and became very slow in October. It was shown that the plants decomposed the insecticidal compounds, and that the lowering of insecticidal concentration with time was probably due largely to this decomposition within the plants.


Sugar beets and strawberry plants were treated with octamethylphosphoramic acid and orthophosphoric acid trimethylamide or tri-(dimethylamino) phosphine oxide, both labelled with \( p^2 \). Both compounds were decomposed at similar rates in the two species of plants. When sugar beet plants treated with the first compound were analysed 10 to 14 after treatment, it was shown that the \( p^2 \) in the beet existed only as the unchanged compound and products not extractable from water by chloroform. When sugar beet plants treated with the second compound were analysed it was found that, besides the unchanged compound and non-chloroform extractable compounds, some material less extractable by chloroform than the tri-(dimethylamino) phosphine oxide was produced. The authors theorized that the plants probably attacked both compounds in the same way, oxidizing them by enzyme action.


The fate of some systemic insecticides and allied compounds after spraying on foliage was studied using \( p^2 \) as a tracer element in them. The results show that, under certain conditions, a fairly high proportion of the applied material may evaporate before there is time for it to be absorbed. Some crop plants absorb bis(bis(dimethylamino)phosphinic acid) hydride and bis-(propionylamino)phosphoric acid at about the same rate as the insecticides are lost by evaporation under windy conditions. The absorption rates on brassica seedlings vary somewhat with the compound applied, and the results fit in best with a theory of absorption through a semi-permeable membrane. The rate is very sensitive to incident radiation, both
visible and infra-red, an increase in the radiation increasing the uptake. The effect is not, however, completely reversible - once sensitized a plant remains unusually absorptive for several days. (auth. summary)


Oxamethylphenylphosphoramide (Schradan) containing radioactive $^{32}P$ was degraded in white clover (Trifolium repens), turnips, Brussels sprouts seedlings, and French beans; heptamethylphenylphosphoramide, a powerful anticholinesterase (probably either hydroxymethyl heptamethylphenylphosphoramide or oxamethylphenylphosphoramide oxide), and ketonic compounds were produced. Oxygenated liver slices and oxidation with $H_2O_2$ produced the same products in similar proportions. Turnips degraded the dimethylamide, monomethylamide, butynilamide, isopropylamide, and Et ester of oxamethylphosphorodiamide acid. The dimethylamide was demethylated to its monomethyl compound; in the other compounds only the dimethylamide groups were attacked. $O,N$-diethyl-$S$-ethylthioethyl phosphorothiolate was converted by plants into at least 3 compounds soluble in CHCl$_3$ and of unknown structure. $O,N$-diethyl-$S$-ethylthioethyl phosphorothiolate was oxidized in plants rapidly to $O,N$-diethyl-$S$-ethylmethylthiethyl phosphorothiolate and another compound of unknown structure; $H_2O_2$ produced the same products. 32 references. (CA 50; 67366, 1966)


It was desirable to develop a new technique, dependent on microdistillation, for separating the insecticide from natural products in crop extracts. The high efficiency of the initial recovery methods, (a) maceration of the crop sample with water, followed by chloroform extraction of the macerate, and (b) direct solvent extraction by boiling under reflux, is proved. The recovery of Schradan added to untreated crops is proved representative of the recovery from a treated crop. The complete analytical technique is described, and blanks and recoveries are listed. This technique should generally be applicable also to determination of residues of other toxic pest control compounds of volatility similar to or greater than that of Schradan. It is possible to determine the $^{32}P$-labelled insecticide and any phosphorus compounds derived from it by various operations, regardless of the large amounts of natural phosphorous compounds present. This makes it possible to account for all the relevant material in a way not possible by orthodox analytical technique. (from auth.)


Review article with 28 references on Schradan. Mention is made of the synthesis of $^{32}P$-labelled Schradan and its metabolism in the rabbit following injection.


$^{32}P$-labelled Schradan and Synlot, organic insecticides, were synthesized and used in studies of spray residues and of their metabolism in the plant. Residues were measured to 0.001 ppm and fall between 0.007 and 0.07 ppm on tree fruits, nuts and potatoes after 4 weeks. After 41 d cotton seed oil contained 109 ppm Schradan while the seed cake contained 167 ppm of non-toxic metabolic products, which were separated from the insecticide by solvent partition. Autoradiographs showed deposition in orange peel and cotton seeds. Metabolic products were separated by countercurrent distribution and by chromatography on treated filter paper. (BA 59; 29631, 1959)


$^{32}P$-labelled OMPA was employed in order to study its behaviour in citrus plants, particularly in the lemon, Citrus limon (L.) Burm., the sour orange, C. aurantium L., and the Valencia orange, C. reticulata (L.) Osbeck. Technical details of the methods and materials used are given. The absorption of the labelled insecticide and $H_2O_2$ from water culture by the roots of the lemon was compared. No significant differences could be detected as measured by translocation and storage in the leaves. After 24 h an average of 20% of the activity was found in the basal leaves (on a ppm basis), 41% in the median leaves, and 30% in the terminal leaves. Over a 50-d period, the distribution was: basal leaves 15%, median 35%, terminal 50%. Absorption and translocation of OMPA following application to bark, leaves and peel are discussed. Lethal dosage levels and greenhouse thrips (Heliothrips citri) of OMPA$^{32}P$ in orange and Citrus Experiment Station, Riverside, CA.


$^{32}P$-labelled Schradan was sprayed on the leaves and stem of cotton plants, and it was shown that the very low chlorophyll-13 radioactivity was significant in the behaviour of systemic (ECT) metabolism. 13 references. (CA 50; 67366, 1966)


The author describe investigations of systemic (ECT) Schradan with that of Schradan proved to be appreciably toxic to Kuch, adults of Paratettixenopis Culex pipiens fatigans Wied. The technical Schradan, purified and containing 1-3 ppm of Schradan, was prepared and tested in a series of 3 experiments. The cotton, C. sativa L. was used for the solution and the more (R.A. 43; 291, 1935)


An aphid (Leptosiphon sp.) is known to feed on plants in the Transvaal, and is of interest in its capacity to cause "rootdie." Tracee-labelled OMPA was used in an attempt to study the translocation of the aphid species. Aphids were tested for total radioactivity and OMPA was determined as a way and further loss took place by leaching of OMPA until more than 15% was lost steadily with time.

628 Thomas, W. D., THE BEHAVIOUR OBTAINED WITH $^{32}P$-LABELLED. Following application of Schradan to surfaces of broad bean and Colomum leaves absorbed more than 15% by 3 processes - evaporation, cuticular surfaces was effectively removed from to other parts of the plant., I appeared to be translocated in to kill aphid feeding elsewhere.
discussed. Lethal dosage levels \( \mu g \) of leaf for adult female citrus red mite (Panorarmychnus citri [McG.]) and greenhouse thrips (Heliothis haemorrhoidalis [Beth]) are cited. Radioautographs showing the distribution of OMP 2A in orange and lemon leaves were obtained. (See also ACSU-3234, California Univ., Citrus Experiment Station, Riverside, 33p.)


\( \beta \)-labeled schradan was sprayed on cotton at the rate of 1.0 pound per acre and after 41 d the extent of contamination of leaves, seeds, raw and refined oils, cake, cottonseed meal, and soapstock was evaluated. Schradan showed a surprising affinity for the oily seeds, and about 8 to 16 ppm was present in the raw oil. Upon refining, this was decreased to 0.05 ppm and the Schradan was transferred to the soapstock. Ground cottonseed meal and cake contained 70 to 80 ppm of radioactive \( \beta \) calculated as Schradan, but the very low chlorine-14 nitrogen hydroxide partition ratio indicated that this material was completely metabolized to soluble products. The experiment demonstrates the value of radioisotope studies in evaluating the behaviour of systemic insecticides. (auth.)


The authors describe investigations with insects and a mite to compare the toxicity of unmetabolized Schradan with that of Schradan after contact with plant or mammalian tissue. The highly purified compound proved to be appreciably toxic by direct contact or ingestion to first-instar nymphs of Aphis medialis Koch, adults of Homotetramychus (Metanotetramychus) citri (McG), and third- or fourth-instar larvae of Culex pipiens fatigans Wied. (q.) and Microstigma auct., and a comparative test showed that samples of technical Schradan, purified Schradan and Schradan prepared from radioactive phosphorus (\( \beta \)) had similar lethal dosages to 48 h for the mosquito larvae 49, 55, and 58 parts per million, respectively, indicating that toxicity is directly related to purity. In tests with the aphid, after introducing Schradan into bean leaves by infiltration or transplantation, a much better correlation was found between toxicity and the content of radioactive compounds in the leaves, than between toxicity and the amount of Schradan metabolized. Observations on mosquito larvae in solutions of radioactive Schradan showed that similar amounts of Schradan were contained in living and dead larvae, proportional to the concentration of the solution and to the mortality caused. Principal mode of entry into larvae may be by ingestion. (RAE-A 48: 921, 1959)


An aphid (Circassica sp.) is known to be the vector for an economically important virus which infects peanut plants in the Transvaal, producing an external or visible foliage and growth symptom locally referred to as "roseate." Trace-labelled OMPA was used in the field, together with the non-radioactive compound, to study the translocation of the insecticide in the plants. A small plot of the plants was sprayed; samples were taken immediately afterwards and at intervals of a few days, up to 25 d. Roots, nuts, and soil samples were tested for total radioactivity only. It was found that decrease in radioactivity in the parts above ground was due to loss of OMPA as a whole. The heaviest loss was due to evaporation immediately after spraying, and further loss took place by translocation within the roots, nut, and soil. There was no decomposition of OMPA until more than 18 d after spraying. The radioactivity in the roots and soil samples increased steadily with time.


Following application of Schradan (\( \beta \)) to leaves, some was absorbed and some evaporated. While the two surfaces of broad bean and Cucum leaves were equally absorptive, the lower surface of apple and chrysanthemum leaves absorbed more than their upper surface. Application of Demeton-\( \beta \) to leaves was followed by 3 processes - evaporation, change into less volatile, toxic derivatives, and absorption, and the chemical was effectively removed from the leaf surface within a few hours. Translocation of I from treated leaves to other parts of the plant occurred, mainly in an upward direction and in amounts sufficient to kill aphids. I appeared to be translocated in the phloem. Translocation from leaves treated with II was never sufficient to kill aphids feeding elsewhere on the plant. Species differences were found in the rate of breakdown of
1 after absorption from leaves. The primary derivatives of H were retained for several weeks, especially within treated leaves. Following root application to broad beans in sand or soil, unchanged H was absorbed and detected in the shoot tip where concentrations of H and its primary derivatives were present in amounts sufficient to kill *Aphis fabae*. Movement in xylem following root application seems to occur freely.


The systemic insecticide, OMPA, was labelled with P, and supplied to the roots of bean plants (*Phaseolus vulgaris*). After uptake it moved through the stem at approximately 20 cm/h, but < 1% of the OMPA supplied had been removed in the above-ground portions after 120 h. OMPA tended to accumulate more rapidly in younger than in older tissues, both in stem and leaf tissues. The P-containing compounds detected in the plant were toxic to *tenebrio*, as determined by bioassay using the two-spotted spider mine, *Tenebrius binotatus* Harvey. Insecticidally inactive breakdown products of OMPA were found after 8 d.

(Also published as AEU-2184, California. Univ., Riverside. Citrus Experiment Station. 20.) Articles of the same title were also published in *Citrus Leaves* 23 (1953) 22, 26 and in the *Calif. Citrology*, 22 (1953) 128, 146, 142. It was concluded that leaf-feeding or injection into the stem might be better methods of applying OMPA.)

**Sytox (Demeton)**


Experimental techniques are described. Some days before the tests the plants were infested with the cotton aphid, *Aphis gossypii* Grote. Reduction in aphid populations was taken as an indication that toxic amounts of the insecticide were present in that portion of the plant on which the insects were feeding. The radioactive Syntox had a specific activity of 4.7 mc/mg, and was diluted with water at 1:800. Translocation of Syntox in the cotton plant was found to occur only in the xylem tissues. It moved in both directions simultaneously but movement in an upward direction was more rapid. Seed from treated plants flowering with Syntox tagged with 35S showed a marked increase in the radioactivity of the young tissues, with a progressive decrease during this period of time. The insecticide was found to be concentrated in the more rapidly growing young tissues.


The labelled sulphur was apparently on the phosphorus in the Systox. O-O-diethyl-O-2-(ethylmercapto)ethyl thiophosphate. Among the studies carried out with this insecticide are translocation experiments, seed treatments, volatility studies, vapour pressure studies, and phytotoxicity studies.


The two isomers Demeton-O and Demeton-S occur as a mixture in the commercial insecticide Syntox, and act on *Aphis fabae* Stock. as contact and systemic insecticides and as fumigants. When applied in the experiments described, as a contact insecticide or systematically through the roots from solution or from soil, Demeton-S was about ten times as toxic to *A. fabae* on broad beans (*Vicia faba*) as Demeton-O. Using Demeton-S containing 35S, it was shown, that when applied to the roots, radioactive material passed to all parts of the plants and that the concentration in the aerial parts was higher than in the roots. Leaf samples were more active than stem samples. By radioassay and by the cut-taproot technique, it appeared that the lethal dose of Demeton-S was equivalent to about 1 mg/kg fresh plant tissue. The lethal dose of Demeton-O, by the taproot technique was 3 mg/kg. From solutions of Demeton-S, the plants first absorbed Demeton-S preferentially, then water preferentially. Demeton-S was more rapidly absorbed from sand than from soil. Both isomers were translocated from older to younger leaves of broad beans, usually in susceptible quantities to kill aphids, but the results were more consistent with Demeton-S. The quantity translocated downwards was small. A low light intensity before and after treatment reduced the quantity of Demeton-S translocated. There was also a reduction in the quantity translocated when the plants were shaded only before treatment. One day of shading was sufficient to cause the maximum reduction. Solutions of the two

isomers gave off toxic vapour from foliage. (RAF-1 49: 518, 1961)


Fukuto, T.R., Metcalfe, R.L. PHOSPHATE (S YSTOX). L. The rearrangement of P-diethylphosphate has been shown to occur in the plants. P-diethylphosphate isomerizes in the presence of water, the isomerization is mainly dehydroalanine and ethyl ketene, benzene and 2.

Preparative details are given.

Fukuto, T.R., Metcalfe, R.L. ISOMERS IN BIOLOGICAL SYSTEMS.

The seven oxidation products of the phosphonic acid (trichlorophosphate, phenylphosphonate, ethylphosphonate, O-O-diethyl-O-2-(ethylmercapto)ethyl thiophosphate, and some of their properties were of interest. A new preparation of paper chromatography, chloroform, and naphthalene homologs were used. A similar comparison of the trichlorophosphate, O-O-diethyl-O-2-(ethylmercapto)ethyl thiophosphorothionate were used. (Rec., Northwestern University)


In this fifth paper of a series, O-O-diethyl-2-(2-ethylthiol) which is the initial red product of the reaction described in the previous series, the isomers from the other series. The isomers from the other series. The isomers from the other series. The isomers from the other series.
isotopes gave off toxic vapours, and plants treated through the roots gave off toxic vapours from the foliage. (RAE-A 45: 218, 1957)

638 Elderswai, M. E., Gordon, H. T. METABOLISM OF C\textsuperscript{14}-LABELED SYSTOX IN THE GERMAN COCKROACH, BLATTELA GERMANICA L. Bull. ent. Amer. 4, 3 (1959) 84, abst. 27.

C\textsuperscript{14}-Systox and phosphate analogue were synthesized from 2-ethylmercaptoanthranil-1,2-C\textsuperscript{14}, through ethyl mercaptan and 2-bromothiophenol-1,2-C\textsuperscript{14}. Isomerization of Systox gave isosystox. Sulfonates and sulfones of the ethylmercaptoanthranil and sulfates of the insecticides were prepared by peroxide oxidation and characterized by paper chromatography. Systox in the cockroach is converted to sulfuric acid and polar compounds.


The rearrangement of 6-ethyliminapentyl diethyl thionophosphate to its isomer 6-ethyliminapentyl diethyl thiophosphate has been investigated using 34\textsuperscript{P}-labelled phosphate and paper chromatography and found to show first-order kinetics. The effect of solvents also has been investigated. Ethyl alcohol markedly increases the isomerization rate, chloroform to a lesser degree, while ethyl acetate, dioxane, methyl ethyl ketone, benzene and 2,4-trimethylpentane have little or no effect. (auth.)

Preparative details are given.


The seven oxidation products of the thiono and thiol isomers, \( \text{O}_2 \text{O} \)-diethyl (S-ethyl-2-sulfurylthiethyl phosphorothionate (thiophosphate sulfonate)), \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphorothiolate (thiophosphate sulfide), \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphate (phosphate sulfide), \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphate (phosphate sulfide), \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphorothiolate (thiophosphate sulfone), \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphorothiolate (thiophosphate sulfone), and \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphorothiolate (thiophosphate sulfone) have been synthesized and some of their properties were compared with the metabolic products of the Systox isomers obtained after topical applications to the base of the cotton plant. The comparison of the results obtained from paper chromatography, cholinesterase activity, systemic activity, mammalian and insect toxicities of the oxidation and metabolic products indicates that the thiono isomer of Systox is converted to the thiophosphate sulfonate, which is then converted to the thiolphosphate sulfone or phosphate sulfide, or to both. A similar comparison of the oxidation and metabolic products of the thiol isomer indicates that it is converted to the thiothiophosphate sulfide and then possibly to the thiophosphate sulfone. P\textsuperscript{34}-labelled \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphorothiolate and \( \text{O}_2 \text{O} \)-diethyl S-ethyl-2-sulfurylthiethyl phosphorothiolate were used. Toxicity tests were made on Metatetranychus citri (McG.), Heliothrips haemorrhoidalis (Nch.), Musca domestica L., Tetramychus telarius (L.) and Aphis gossypii Glov. (Includes auth. summary)


In this fifth paper of a series, an account is given of further investigations on the chemical behaviour of \( \text{O}_2 \text{O} \)-diethyl S-2-(ethylythio) phosphorothiolate (Demeton-O), one of the two isomers present in Systox, in which the infra-red spectra of its metabolic products were compared with those of the synthetic oxidation products, in order to confirm the suspected identity of the metabolites. Demeton-O labelled with P\textsuperscript{34} was applied to the bases of young cotton plants and its metabolites were recovered from the leaves and isolated by the methods that are described. The results showed that the major metabolic product in the plant 4-6 days after application occurred with \( \text{O}_2 \text{O} \)-diethyl S-2-(ethylythio) phosphorothiolate (the thiophosphate sulfone). When this compound labelled with P\textsuperscript{34} was applied to plants in the same way, the spectrum from the metabolite isolated after two weeks proved that subsequent oxidation of \( \text{O}_2 \text{O} \)-diethyl S-2-(ethylythio) phosphorothiolate (the thiophosphate sulfone) occurred at a somewhat slower rate than the conversion of Demeton-O to the thiophosphate sulfonate. (RAE-A 45: 181, 1957)

637 Gardner, K., Heath, D.P. QUANTITATIVE DETERMINATION OF ISOMERS OF O, 2-DIETHYL ETHYL-

The identification technique described - concurrent
portation chromatography of the unknown sample with radioactive components of established
structure and purity - may find more general application, particularly to preparations of the
S=P-O and O=P=S type.

638 Hartley, G.S. RESEARCH DEVELOPMENTS. THE ANOMALY OF SYSTOX. World Crop. 4 (1953) 397.

The anomaly of Systox lies in the fact that it acts as a systemic insecticide while only soluble to the
extent of 1 part in 15,000 of water. Systox contains 2 active ingredients, the S=P-O=C and the O=P-S-C
compounds. The labelled system was separated and concentrated. A third, even more water-favourable compound was also discovered, and shown to possess anti-cholinesterase
activity. The original compounds may thus be seen to be rapidly and completely converted into the
derivatives, which persist for several weeks. This may explain why it has been reported that toxic residues disappear very rapidly with Systox treatment, despite its persistence as an insecticide.


Of the components of technical Demeton and related compounds have been separated by means of 2 paper
chromatographic techniques, and of technical Schradan and related phenoxyacids by means of a
third paper chromatographic technique. 2H or 3H were used for labelling. The above techniques have
materially aided in investigations on systemic insecticides, for the preparation and determination of purity of
3H-labelled Demeton and its isomerisation to the thiol isomer (see Fukuto & Metcalf, J. Amer. Chem.
Soc., 76 (1954) 6109); the translocation and biochemistry of Systox (Demeton) in plants; the determination and characterization of residues of Systox in citrus, walnut, apple, pear, potato, and sugar beet; the preparation and the determination of purity of 3H-labelled Schradan, determination of its residues in cotton, and some studies in comparative biochemistry.


2H-labelled thiono and thiol isomers of Systox were found to be rapidly metabolized, degraded, and
eliminated in the white mouse and the American cockroach. Metabolism, degradation and elimination are
somewhat slower in the cockroach than in the mouse, but in general they are the same. The
forested exhibits a marked selective absorption of the isomer, and the gut is the principal avenue
of elimination. Although the gut appears to be the most active tissue in the role of metabolism and
degradation, other tissues such as nerve and muscle are more active in the roach than in the mouse.
The principal pathway of metabolism to toxic metabolites for both isomers is the oxidation of the mercapto
sulfur of the ethylenemercaptoethyli moiety to the sulfoxide and sulfone. A secondary pathway in the case of the
thiono isomer involves the oxidation of the thiol sulfurs to produce the phosphate and its sulfoxide
and sulfone. Both isomers and their toxic metabolites are degraded by hydrolysis and of the P-O
or P-S bond to form the alcohol and acid. The routes of metabolism and the toxic metabolites formed are
the same in plants and animals. Toxic residues in edible produce present no peculiar hazard as a result
of biochemical activity in the plant. (from abstract summary)

The 14C-labelled isomers were readily absorbed by the roots and stems of the lemon seedlings and translocated to the leaves in amounts toxic to \textit{Pestsystaxomum} (\textit{Metasestaxomum} citri M.C.), and \textit{Heliotrichia haemorrhoidalis} (Beh.). The translocated materials were present in greater quantity in the peripheral growing areas of the upper leaves, and the systemic behaviour closely resembled that of Schadan. After topical application to the stems, radioactivity accumulated in the upper leaves of bean and lemon 5-10 times as fast for \textit{Demeton-S} as for \textit{Demeton-O}. Studies of the quantitative metabolism of the two isomers in bean and lemon leaves by paper chromatography indicated a rapid metabolism of both. Contact toxicity studies in which oranges were dipped in standard solutions and the dry residues tested showed that \textit{Demeton-S} is 3-5 times as toxic as \textit{Demeton-O} to \textit{P. citri} and \textit{H. haemorrhoidalis}; the metabolite of the former caused total mortality at an estimated concentration of less than 40 \textmu g/g leaf, and the metabolite of the latter at about 300 \textmu g/g. Pure \textit{Demeton-O} was a poor inhibitor of fly-brain cholinesterase, but \textit{Demeton-S} and the principal metabolites of both isomers were highly active. No radioactive vapours were recovered from the leaves of plants of which the stems had been treated with the radioactive isomers. 

(RAE-A 48; 421, 1950)


The systemic behaviour of \textit{Demeton-S} and its methoxsure and sulfide (\textit{O}, \textit{O}-diethyl 2-ethyl-2-sulfuryl-ethyl phosphorothioate) applied topically to the stems of young cotton plants was studied by means of \textsuperscript{38} radiotracer and paper chromatography. \textit{Demeton-S} was absorbed and translocated much more rapidly than the sulfide for up to 7 days after application. At 14 days, the amounts were nearly equal, and at 30 days the sulfide was present in appreciably greater amounts. The methylsulfate accumulated much more slowly, indicating a lower degree of penetration of this strongly polar compound through the plant cuticle. The rates of metabolism and decomposition of \textit{Demeton-S} and its sulfide were approximately the same, and small amounts of the sulfone were formed from both. Radioautography after topical application to young lemon leaves showed that the penetration and spread in the leaf interior was most rapid for \textit{Demeton-S} and least so for its methoxsure, but more rapid for \textit{O}, \textit{O}-diethyl 2-ethyl-thioethyl phosphorothioate (\textit{Demeton-O}) than for \textit{Demeton-S} sulfide. (From auth. summary)


The investigations were largely carried out by means of \textsuperscript{38} labelled \textit{Systox} isomers, \textit{O}, \textit{O}-diethyl 2-ethyl-2-mercaptoethyl phosphorothioate (thioisomer) and \textit{O}, \textit{O}-diethyl 2-ethyl-2-mercaptoethyl phosphorothioate (thiol isomer), and paper chromatography. Samples of apples, pears, oranges, walnuts, potatoes, and sugar beets were processed for analysis. The metabolism of the isomers and their residues produces, and the action of air and sunlight on surface residues are discussed. In addition to activation within the plant tissues to oxidative metabolites, these are subsequently hydrolyzed to non-toxic, diethyl phosphoric acids and alcohols. The thiol isomer metabolites persist in leaf and fruit tissues about twice as long as the thione isomer metabolites. The hydrolysis of the toxic metabolites in plant materials to non-toxic phosphoric acid derivatives is a further safeguard against the retention or accumulation of the toxic esters over a long period of time. Average residue values of toxic \textit{Systox} metabolites 2 and 4 weeks after application were substantially below 0.1 ppm, i.e., so that they could not have been determined precisely by other (non-tracer) methods.


The translocation of \textit{O}, \textit{O}-diethyl S-2-(diethylamino)ethyl phosphorothioate (thiol isomer) and its salts, particularly the hydrogen oxalate, in plants was investigated by the use of compounds labelled with \textsuperscript{38} and compared, in some cases, with that of its thione isomer \textit{O}, \textit{O}-diethyl O-2-(diethylamino) ethyl phosphorothioate and \textit{Demeton-S} \textit{O}, \textit{O}-diethyl S-2-(ethylthioethyl) phosphorothioate. Cotton, lemon, and orange plants were used in experiments, and the distribution and metabolism of thiol isomer and its oxalate discussed. (From RAE-A 46; 5, 185-9, 1955)


The chemical behaviour of methylthiosystox, \textit{O}, \textit{O}-dimethyl S-(2-ethyl-mercaptoethyl) thio phosphorothioate, Methylthiooxoroxiphoxide and Methylthiosystox-sulfine was examined in the plant in the mammalian
organism by means of $^{14}C$-labelled compounds. Two toxic transformation products were found in the plant. In addition to sulphoxide, methylyglyoxysulphone was also identified in plants treated with methylyglyoxysulphone. Both methylyglyoxysulphone and its oxidation products, sulphoxide and sulphone, are exposed to the normal hydrolytic decomposition to non-toxic compounds in the living plant. The first decomposition product is dimethyl phosphoric acid, the end product of orthophosphoric acid. It could be proved that the phosphoric acid formed by complete decomposition of the "systemic" active substances is largely used by the plant for the synthesis of phosphates (particularly in lecithins). True residual values are considered below those calculated at random on the basis of the total $^{14}C$-content. The sulphoxide primarily formed in the plant is excreted quantitatively from the organism of warm-blooded animals within a short time. Cases of chronic poisoning cannot be caused following the consumption of such small quantities as represented by the residues in the harvest crops.


A 0.05% Systox spray was used in which the third isomer of Demeton, Demeton-S, was labelled with $^{14}C$, and used in a determination of the dissipation of residues in tobacco and potatoes at various times after application. A so10 application of 0.05% at the rate of $2 g a i l y$ resulted in 666.5 to 428.9 ppm in tobacco leaves 88 d later, and 89.2 ppm (wet weight) in potatoes.


Sprays were used where the Systox ingredients were present in their normal proportion but the Demeton-S was labelled with $^{14}C$. The method of spraying and sampling as applied to tobacco and potatoes is described, and was also used to determine how much of the insecticide or of its more toxic degradation products is present in potatoes and tobacco at various intervals after treatment (cf. Stein and Smith, 1964). The CHCl3 extract which contains the toxic portion of Systox degradation products was found to be 5 ppm (dry weight) in tobacco leaves and 1.2 ppm (wet weight) in potato tubers 88 d after soil applications of 0.05% at the rate of 2 g a.i./y.


The systemic insecticide Systox normally contains a mixture of the two isomers, diethyl 2-(ethylthio)ethyl phosphorothionate and diethyl 3-2-(ethylthio)ethyl phosphorothiocarbamate, or Demeton-O and Demeton-S, respectively. Demeton-O is toxic to honey bees, and substantial amounts may possibly be transported in nectar by them and contaminate the honey. Demeton-S has been shown to be about ten times as toxic as Demeton-O to mammals and insects, and investigations were therefore carried out to ascertain whether it, or any derivative, appears in the nectar of sprayed plants; also, its rate of translocation and breakdown in the plant. $^{14}C$-Demeton-S was used. The fate of Demeton-S in white mustard (Brassica alba), borage (Borago officinalis) and field bean (Vicia faba) was followed over several weeks by means of the radioactive tracer technique. Radioactivity of nectar samples from flowers that opened a few days after spraying showed no unchanged Demeton-S, but degradation products were present in small amounts. The highest value for total radioactivity found in the nectar corresponded to 2.7 parts per million expressed as Demeton-S. Radioactivity of treated leaves and new growth after spraying confirmed that Demeton-S is rapidly converted in the plant into two primary degradation products extractable by chloroform. Further breakdown occurs and is still more rapid in new growth, but appreciable quantities of the two primary degradation products are retained by treated leaves for several weeks after spraying. Chrysanthemum cuttings which had absorbed an extract of them proved toxic to Macrothylax (Macrothylaxia) sanborni (Gill.). It is concluded that the extent to which Demeton-S appears in the nectar is negligible, but that some contamination by degradation products, possibly toxic to man, occurs. (RAE 45: 469-105, 1965)


Following leaf application of 5-2-(ethylthio)ethyl phosphorothionate (Demeton-S) labelled with $^{14}C$, to beans, apples, and coleus, evaporation, breakdown into toxic non-volatile compounds, and absorption occurred concurrently and effectively removed unchanged I from the leaf surface within a few hours. Evaporation gave rise to absorbed, I-degrading rapidly with time. Following root application to bean, 1 d; unchanged I was translocated much more freely in xylem than the other fractions.


A brief note is added to an earlier paper (1966) on the normal spraying with $^{14}C$-labelled Demeton-S show that fruit and vegetables are not contaminated. (EMAS 34: 169-170, 1966)

651 Tietz, H. DER MIT $^{32}P$ MARINIERTE SYSTEMECHTHALT IN PFLANZEN UND SEIN WÄRTSTANDER EINES C 1968 (the active substance of Baygon) and applied to roots or soil and its accumulation in the leaf and root residual effects, including root growth, freely from solution by the influence of concentration limit. The penultimate normal value, and finally to shoots in the absence of the growth. Spraying or brushing of the leaf depending on several factors. To increase the spread of the plant, particularly spatially. Autoradiographs of leaf cross-sections and in cells of the phloem and xylem exudation via cuticle pores, much the phloem. Evaporation or absorption.

652 Tietz, H. METABOLISME DES SYSTEMEICIDES. Phytophysiologie 9 (1964) 1-16.

Le methylyglyoxysulphone (marque sur $^{14}C$) was to Heath. Les surfaces et les surfaces des plantes. On a pu observer que les acides glutamques se transforment dans une large mesure en produit qui est en position dans le dehors. Dans l'acide aspartique à sang chaud. En cas de l'absence dans les produits de résistance naturelle.


TEPP (tetraethyl propylphosphonate) is the $^{32}P$-labeled compound of radiobiological assays. About 10% of radioactive TEPP or its metabolites occurred in the forage gut, with a sharp increase in the 1st week. This sharply; slight increases were not lethal and lethal administration, and of surviving and proximate code.
on products were found in the plant, in plants treated with Methylcystox, and with the normal degradation products are decomposed and the raw data for the synthesis are considerably below those calculated from the plant is exceeded by the inorganic residues. Cases of chronic poisoning are represented by the residues in the

SYSTEMIC INSECTICIDES.

Demeton-S, was labelled with $^{32}$P, potatoes at various times after treatment: 8, 14, and 21 d in 550 to 690. 9 pm


A brief note is added to an earlier communication (Mühlmann and Tiets, Höchstler. Wiss. 9, 2 (1966) 110). Whereas the previous study described data under conditions designed to obtain maximum residues, normal spraying with $^{32}$P-labelled insecticide in early summer instead of autumn was applied. Results show that fruit and vegetables are perfectly safe for human consumption after 8-10 d from the last spraying.

Tiets, H. DER MIT $^{32}$P MARKIERTE DIETHYLTHIONOPHOSPHOSPHORUSWIRKSTOFF DES D-OXYETHYL-DIOXOTHIO- PHOSPHORUSWIRKSTOFFES DES SYSTEMISCHEN INSEKTIZIDES "SYSTOX," SEINE AUFNAHME IN DIE HOHE GE PFLANZEN UND SEINE WANDERUNGSVERMÖGEN. (The $^{32}$P-labelled diethylthionophosphoric acid ester of $\alpha$-oxoethylthiodioxide, the active substance of the systemic insecticide Systox, its uptake by higher plants and its translocation) Höchstler. Wiss. 9, 7 (1966) 1-66. (In German)

E 1029 (the active substance of Systox) was labelled with $^{32}$P(supplied by G. Schaefer, Farbenfabriken Bayer) and applied to roots or leaves, in order to study its absorption through roots, its upward movement, and its accumulation in the leaves. Penetration and movement were traced after leaf application, and residual effects, including storage and detoxication by plants were studied. The insecticide was absorbed freely from solution by the intact root. The quality of treated soil was found to influence uptake and accumulation. The permeability of the root for water increased over a long period, then dropped below the normal value, and finally adjusted to it. After absorption by the root, the insecticide was translocated to shoot organs above the ground. Temporary storage, particularly pheoplastic, was observed in leaves. Spraying or brushing of the leaf with Systox solution allowed greater inward penetration, the degree depending on several factors. Treatment of individual leaves resulted in a displacement towards untreated parts of the plant, particularly pheoplastic. Once within the leaf, the insecticide did not appear to diffuse widely. Autoradiographs of leaf cross-sections indicated temporary storage by living cells, particularly in the epidermis and in cells of the connecting bundle parenchyma. Loss from the plant occurred chiefly through exudation via cuticle pores, translocation after treatment of the shoot part above the ground primarily via the phloem. Evaporation or rain removes the eliminated toxic particles from the surface.


Le Methylcystox (marqué au $^{32}$P) est transformé en composés toxiques conformément aux observations de Heath. Les sulfoxydes et les sulfoxydes des matières actives, du "Systox" sont identiques à des dérivés D1 et D2. On a pu prouver que les acides phosphoriques résultant de la décomposition complète de la matière active se transforment dans une large mesure en phosphates végétaux (surtout en héctidine). Le sulfuroxide que se produit en premier lieu dans la plante est désintégré quantitativement en peu de temps de l'organisme des animaux à sang chaud. En cas d'intoxication aiguë chez la souris blanche, 97% du sulfuroxide sont éliminés (15 h); il en résulte que l'absorption de faibles quantités du produit comme p. e. des résidus se trouvant dans les produits de récolte ne peut conduire à des intoxications chroniques.

Teppe


TEPP (trisatriethyl phosphineoxide), triisopropyl phosphorothionate, tri-$p$-butyl phosphorothionate and D-Di-ethyl D-o-panethiophosphorothionate were synthesized with $^{32}$P and used in studies employing the techniques of radiobiological assays. Among others, experiments were made to determine the tissue concentration of radioactive TEP or its metabolite during topical application which showed that the highest concentration occurred in the core gut, with the concentration in the body fluid rising rapidly at first and then falling sharply; slight increases were noted in muscle tissue during the first hour after treatment. After both sublethal and lethal administrations, the core gut showed a marked selective absorption of TEP in the tissues of surviving and postmortem cockroaches (Periplaneta americana (L.)) showed considerably higher concentrations.
of radioactive material in the fore gut of surviving than of prostate cockroaches, and higher concentrations in the muscles of prostate than of surviving ones. Although no radioactive materials were detected in the central nervous system, the authors do not consider that this necessarily indicates a complete absence of such materials from this region, since the specific activity of the tracer compound employed had deteriorated to a rather low level when the experiment was performed.


A method for the synthesis of $^{32}P$-labelled tetraethyl pyrophosphate (TEP) is described. The corresponding specific activity of the product is 65 μC/g but this could be increased by altering the ratio of active to inactive $P$ and no modification of the technique would be required. The over-all chemical yield based on $H_3PO_4$ is 45%. (CA 49: 999a, 1955)

Thiodan

Klee, O. ÜBER DEN EINFLUS der TEMPERATUR UND LUFTFEUCHTIGKEIT auf die TOXISCHE WIRKUNG ORGANISCH-SYNTHETISCHER INSEKTIZIDE. (Study on the influence of temperature and humidity on the toxic effects of organically synthesized insecticides) Z. angew. Zool. 47 (1960) 183-220. (In German)

Insects were exposed to the vapor phase of the $^{32}P$-labelled insecticide Thiodan. Contamination of any one part of the body which might be in contact with precipitated material could thus be avoided. By measuring the radioactivity taken up from the vapor at different temperatures and levels of humidity it was possible to determine the extent to which insecticide efficacy was a function of these factors, and to demonstrate the importance of the vapor phase.

Miscellaneous


The insecticide (Bayer 25141) was studied with regard to its chemical instability to heat, hydrolysis, and oxidation and to the effect of the products formed upon insect toxicity. The compound is readily oxidized to the sulfoxide and upon heating undergoes internal oxidation-reduction to also form the sulfide. Additionally, the compound apparently isomerizes very readily to form the $S$-ethyl-isomer. The oxidation and isomerization products also form in aqueous systems such as the insects body and as they possess enhanced anticholinesterase activity apparently contribute to the mechanism of toxic action which appears to be that of inhibition of cholinesterase. The bimolecular rate constant for reaction with cholinesterase and the hydrogen-ion catalyzed hydrolysis constant for $p$-substituted methylthio-, methylsulfinyl-, and methylsulfonylphenyl diethyl phosphates and phosphorothionates can be satisfactorily correlated with the electron-withdrawing capacities of the aryl substituents. A $^{32}P$-labelled form was used, the insect studied being Periplaneta americana. The techniques for paper chromatography, quantitative evaluation of $^{32}P$-labelled compounds and identification of the various metabolites are given.


The above insecticide (Bayer 25141), its dimethyl analogue, and several reduced and oxidized derivatives were investigated as contact and systemic insecticides. The more active compounds studied were of the same order of contact toxicity as Pyranthion and were also effective systemic insecticides. In plant tissue, the sulfoxides are oxidized to sulfoxides and also appear to isomerize to $S$-ethyl-isomers. Compounds $p$-CH$_3$SO$_2$H$_2$OP (P)CHOH and $p$-CH$_3$SO$_2$H$_2$OP (5) (OMe)$_2$ were available in highly purified and in $^{32}P$-labelled preparations. Experiments were carried out on Musca domestica Linn., Periplaneta americana (Linn.), Metamauchenius citri (McGregor), Tribolium confusum (Duvall), Laphygma frugiperda (J. E. Smith), and BrachylvYM binaecae (L.), and contact toxicity of $p$-substituted phenyl diazyl phosphorothionates and phosphates determined. Results on contact toxicity, systemic toxicity, rates of absorption and translocation are discussed.

Bowman, J. S., Casida, J. E. SYSTEMIC INSECTICIDES FOR THEOBROMA CACAO L. THEIR TRANSLOCATION AND PERSISTENCE IN FOLIAGE AND RESIDUES IN CACAO BEANS. J. econ. Ent. 51; 6 (1958) 77-80.

From preliminary screening of H-6200 1(2)-diethyl-1-(3-diethylphosphorothionyl)-1,3,4-diazole (EDP), selected for further study. The absorption of the foliar parts of cacao leaves by the aphid to the aphid was not found to be significantly lower than that found in the control. The data therefore cannot be used for a complete study of the aphid. (auth.)


The biological distribution of N-(2-methyl-1-propenyl)-N-p-dimethylaminophenyl phosphorothionamide, a new compound currently available, compounds to produce the effective toxic isomers for the aphid. Accumulation seemed to occur in the cacao beans and nerve cord of the aphid. (auth.)

Casaecho, J. M., Gattenham, P. J. SYSTEMIC INSECTICIDE Q. O-DIMETHYL 1-carbethoxy-2-methyl-1,4-dihydro-4-oxo-3,6-diisopropyl-1,2,4-triazine 2,4-dione. J. econ. Ent. 60; 3 (1967) 537-41.

O-Dimethyl 1-carbethoxy-2-methyl-1,4-dihydro-4-oxo-3,6-diisopropyl-1,2,4-triazine 2,4-dione 544C consists of about 90 percent to insects and mammals. Desulfurization was negligible attack on both Isoles within 9 of the vinyl phosphoric ester. Loss in less than 2 d and over residues in crop plants treated following insecticide applications by different techniques, amongst others. (auth.)


Some phosphorothionates show promise taken to measure the hydrolysis of water. It was found that the phosphorothionates, but is extremely stabile to hydrolysis and the rates of hydrolysis are described, and all the rest $^{32}P$-labelled form of $N$-diethyl-$N$-methylphosphorothionamide, a member of this class of compounds, is $^{32}P$-labelled form of $N$-diethyl-$N$-methylphosphorothionamide. (auth.)


The rates of hydrolysis, in all cases, are alkaline- and alkali-labile. The mechanism is of type $S_{N}A$. (auth.)

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From preliminary screening of 14 systemic compounds with cacao seedlings in Costa Rica, Thimet, Chipman R-8200 (O-(2,5-diesthylbenzyl)-5-(2,5-diethylaminoethyl) phosphorothiolate), Dimetron, Isolan and Dimexon were selected for further study. These five systemic compounds were compared on the basis of their translocation and persistence in the foliar parts of mature cacao trees after trunk implantation, their effect on the flavour of chocolate produced from beans of the treated trees, and the level and nature of residues in the beans using radioactivity and anticholinesterase methods of analysis. Thimet and Chipman R-8200 were readily translocated into the foliar portions of cacao trees and persisted for as long as 20 months after a single implantation treatment. Little or no residues were found in the cacao beans at any time after treatment regardless of the position on the trees in relation to the site of implantation. Studies with radioactive R-8200 (labelled with 32P) demonstrated a high concentration of phosphorus-containing residues in the coryledons of the cacao beans but these materials did not partition into chlorophyll and did not inhibit cholinesterase, and therefore cannot be considered hazardous residues. No off-flavours were detected in chocolate from beans harvested from any of the systemic treatments but definite off-flavours were obtained when BHC was used as a foliar spray. (auth.)


The biological distribution and fate of the cis isomer of compound 2046, O-(2,5-dimethyl-1-carbo-methylene-1-propen-2-yl) phosphate, was studied after being labelled with 32P, since substituted-vinyl phosphates are noted for frequently high insecticidal activity. It was found that in contrast to other systemic insecticides currently available, compound 2046 does not require preliminary "metabolic activation" within the plant to produce the effective toxicant. The substituted-vinyl phosphates had the shortest residual period of 30 organo-phosphates studied on carrots, potatoes and cabbage. Distribution and detoxification were studied. Accumulation seemed to occur in the mid- and hindgut; detoxification appeared to take place in the gastric caeca and nerve cord of the roach, Periplaneta americana.


O-(2,5-dimethyl-1-carbo-methylene-1-propen-2-yl) phosphate (compound 2046) offers considerable promise as a short-residual systemic insecticide. The potential hazard of residues in crop plants was investigated. Compound 2046 consists of about 6% cis and 94% trans isomers. The cis is about 100 times more toxic than the trans to insects and mammals. Despite the greater residual persistence of the trans isomer within the plant, its residual hazard was negligible compared to the less stable but more toxic cis material. The initial enzymatic attack on both isomers within the plant appeared to be on the carbonyl ester group, followed by hydrolysis of the vinyl phosphate bond. Foliage application to vegetable crops in the field resulted in a 90% residual loss in less than 3 d and over 99% loss in 4 d based on anticholinesterase determinations. The toxic 2046-residues in crop plants treated at dosage levels used for insect control were essentially dissipated within 2 d following insecticide application. The residual properties of compound 2046 were determined by several different techniques, amongst them radioactive insecticide, using 32P as tracer. Its synthesis is described. (auth.)


Some phosphonamides show remarkable toxic properties towards mammals and insects. The study was undertaken to measure the hydrolysis rates of some dimethyldiamides of phosphoric acids in acids, alkalis and water. It was found that the P—N link is about as easily broken by acids as the C—N link in organic amides, but is extremely stable to alkalis. Only in acid amides, containing the group N—P—OH, is the P—N group broken by water at a measurable rate. Other modes of hydrolysis of some of these compounds are described, and all the results considered in relation to the behaviour of organic amides. A radioactive, 32P-labelled form of R2P(O)O, was used in the study. (auth.)


The rates of hydrolysis, in alkaline solution, of compounds of the types R2P(O)O and R2P(S)X, where R and R' are alkyl- or alkylamino-groups and X is an acidic group, are summarized, and more results are given. The mechanism is of type SnO. The electromeric and inductive effects of substituents are usually very

OMA CACAO L., THEIR TRANS-BEANS. J. econ. Ent. 51, 6 (1958)
similar to those found in carbon chemistry for reactions of this type. However, ethyl N,N-dimethylphosphoramidocyanidate and compounds containing P=C bonding are hydrolyzed exceptionally rapidly, perhaps because the cyanide group and the sulfrur atom are very readily polarised to the other substituents considered. In the phosphorodiamidic fluoride series, these compounds containing four alkyl substituents are hydrolyzed markedly more slowly than those containing only three, owing to a steric effect. For the same reason dimethylpropylphosphonofluoridate is hydrolyzed more slowly than would be expected from its structure. All rates of reaction in neutral solution and several of the slower ones in alkaline solution were determined on compounds labelled with P32. This is the most accurate of the methods used.


The approach used in the preceding paper is extended to cover rates of hydrolysis in compounds under conditions such that catalysis by hydroxy ion can be neglected. Hydrolysis rates were obtained using very dilute solutions of P32-labelled compounds. Salt catalyses hydrolysis of N,N-diglycyl- and N,N-di-methyl-4-16-propylphosphorodiamidic fluoride. For the first compound is probably competitive, water acting as both an anion and a cationid reagent. Generally, however, water acts as an anion by an SN1 mechanism. Substituents have similar effects to those described in Part I, except that in the tetra-alkyl pyrophosphates steric effects are more important than inductive effects, and that P=O=C groups accelerate the rates less in neutral than in alkaline solution.


The nature of the products formed by in vitro and in vivo hydrolysis of Parathion, methyl Parathion, Diazinon, Dow ET-57, Chlorpyrifos, and Dicofol was investigated. All these dialkyl aryl phosphorothioates were hydrolyzed at both the alky1-phosphate and the aryl-phosphate bonds. Alky1-phosphate hydrolysis was proportionately greater with the dimethyl than with the diethyl phosphorothioates in rats and under the alkaline conditions employed. Very little alkyl-phosphate hydrolysis occurred with cockroaches with five of the six compounds studied. The lower alkyl-phosphate hydrolysis with cockroaches as compared to rats may contribute to the lower relative toxicity of the dimethyl aryl phosphorothioates to mammals. Differences were also noted in the rate of oxidation of the various hydrolytic metabolites between rats and cockroaches. Six phosphorothioate insecticides (Dow ET-57, Chlorpyrifos, methyl Parathion, and Diazinon) used in the study were synthesized from P32 pentasulfide prepared by isotope exchange. Subsequent treatments are described. (from auth.)

II - E Pyrethrins and related Compounds


C14-labelled di-cis, trans-Allathrin has been synthesized. The procedure for a successful paper separation of the di-cis from the di-trans chrysanthemum acids is described. A comparison of the 8 isomeric labelled Allathrin was of interest. Some attempts were made to analyse certain zones of impurities also obtained, but present data do not permit an interpretation of their nature and origin.


Radioactive Allathrin has been synthesized to facilitate a study of the metabolic fate of toxic esters of chrysanthemum acid after their application to houseflies and cockroaches. After having been purified by chromatography, the radioactive Allathrin appeared to be approximately 98% pure. (auth. summary)


Traces of five contaminants to ammonialc ethanol; one to ammonialc isopropl acetanethamic acid and a mixture of Skellysolve B, of an unknown logical explanation for the pyrethrin. Allathrin are hydrolyzed during products may be produced by have been observed on chromo.

Blum, M. S., Kearns, C. W. COCKROACH. J. econ. Ent. 61, 6 (1959) 800-8.

Increased toxicity at lower temperatures. This phenomenon was investigated relationship between toxic in with C14 were used. The same with the concentration of a toxic of adults of Sarcophaga cras astrig cockroaches kept at 12°C was absence of radioactivity in the toxin was not a pyrethrin n or became paralyzed almost about the same as that of biothe pyrethrum extract increases by observation of paralysis and that the synergist was present in blood. The toxic agent in bio-temperature (26-27°C). (from auth.)

Bridges, P. M. ABSORPTION Biochem. 6, 6 (1957) 361-6.

Allathrin labelled with C14 adult houseflies. After a method by paper chromatography, the female houseflies was metabolism 1hr of this period was 8% abdomen homogenate were and homogenates could not be determined was some evidence that benzo concentrations used. Absorbtion. The fraction of the dose absorbed (CA 51:1971g, 1957)


The following insects were used: Mucro domestica L., a pyrethrum Sarcophaga crassagulae, and a benzene and Allathrin in the the rate of Allathrin penetralic were found useful in this inves reduces the rate of detoxification.

Hopkins, T. L., Robbins, W. E. ALLATHRIN BY HOUSE FLIES. The fate of pyrethrin insecticides, using Allathrin labelled
However, ethyl NN-dimethylphosphorylated exceptionally rapidly, perhaps used relatively to the other substituents containing four alkyl substituents are log to a static effect. For the same would be expected from its structure, an alkaline solution were determined of the used.

DIOLYSIS OF SOME ORGANO-J.
J. chem. Soc. (1960) 869-8. 8
hydrolysis in compounds under con-
etrates were obtained using very
of NN-dimethylpropyl and NH-di-
ound is probably composite, water r,
water acts as an anion by an S\textsuperscript{-}2
1, except that in the tetra-alkyl
and that P-S-C groups accelerate

5 INSECTICIDES ON THE GRAN (BUG

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J. econ. Ent. 51, 6
Parathion, methyl Parathion,
are dialkyl aryl phosphorochlorides
alk. Alkyl-phosphate hydrolysis was
thiosalicylate in rats and under the
served with cockroaches with five
cockroaches as compared to rats
horditosan to mammals. Different
metabolites between rats and cock-
ruthenium, methyl Parathion, Para-
ulfide prepared by isozone exchange.

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LABELLED AND UNLABELLED
ation for a successful paper separation
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ions of impurities also obtained. 8

OMATOGRAPHIC PURIFICATION
metabolic fate of toxic eaten of
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ely 99% pure. (auth. summary)

LETHAL DETERMINED BY PAPER
(8) 185.

Traces of five contaminants were found in the reversed-phase chromatogram of C\textsuperscript{4}L-Allethrin with respect to ammonical ethanol; one (A) at R\textsubscript{f} 0.0 and a mixture of four (C) at R\textsubscript{f} 0.84. This mixture, with respect to ammonical isopropanol acetate, consisted of an unknown D at R\textsubscript{f} 0.0, both di-C\textsuperscript{4}L and tria-C\textsuperscript{4}L-chrysanthemic acids, and a mixture at R\textsubscript{f} 0.84. The last mixture consisted, with respect to ammonical isopropanol acetate, of an unknown E at R\textsubscript{f} 0.0 and dinitrobenzene in D at R\textsubscript{f} 0.84. At present, the most logical explanation for the presence of chrysanthemic acid and dinitrobenzene is that traces of Allethrin are probably utilized during reversed-phase chromatography by the ammonical solvent. However, these products may be produced by some other reaction, such as photo-decomposition, because zones A and C also have been observed on chromatograms prepared in the absence of ammonium.


Increased toxicity at lower temperatures has been reported for various insecticides, including pyrethrum. This phenomenon was investigated for a possible correlation between toxicity and penetration, and for the relationship between toxic materials in the blood and symptomatic reaction. Pyrethrum solutions labelled with C\textsuperscript{4}L were used. The symptoms of poisoning manifested by pyrethrin-treated cockroaches were correlated with the concentration of a toxin in the hemolymph as determined by bioassay from the duration of paralysis of adults of Sarcophaga crassifasciata Maqu, into which 3 or 6 \textmu l blood was injected. Blood from treated cockroaches kept at 15°C was toxic to the flies when the same amount from flies kept at 35°C was not. Absence of radioactivity in the blood of cockroaches treated with C\textsuperscript{4}L-labelled pyrethrin indicated that the toxin was not a pyrethrin or metabolite. If cockroaches were treated with a high concentration of pyrethrin and became paralyzed almost immediately, the toxicity to flies of blood removed several hours later was about the same as that of blood removed as soon as prostration had occurred. Piperonyl butoxide applied with the pyrethrin extract increased the susceptibility of the cockroach to it at higher temperatures, as indicated by observation of paralysis and by demonstration of the existence of the toxin by bioassay. Analysis showed that the synergist was present in the fat-body and the central nerve cord of the cockroach and absent in the blood. The toxic agent in blood lost almost all its activity when the blood was stored for 8 h at room temperature (28-27°C). (from RAE-8 66:54-6, 1958)


Allethrin (L) labelled with C\textsuperscript{4}L was incubated with enzyme extracts or homogenates or it was injected into adult houseflies. After a metabolism period, any unchanged L and its metabolite were extracted, resolved by paper chromatography, and determined radiochemically. A considerable fraction of the L injected into female houseflies was metabolized in a period of 24 h. The proportion of the metabolism occurring in the 1st h of this period was 80%. The net weights of L metabolized by a male lipase extract and a female abdomen homogenate were small and of doubtful significance. Metabolism of L by female thoracic homogenates could not be detected. A sublethal exposure to MeBr inhibited the metabolism of L. There was some evidence that benzylxide, a lipase inhibitor, reduced the metabolism of L in vivo at the higher concentrations used. Absorption of topically applied L-C\textsuperscript{4}L was rapid during the 1st 5-10 h after application. The fraction of the dose absorbed in 24 h approached unity at lower doses but fell off significantly at higher doses. (CA 51: 16971g, 1957)


The following insects were used in these experiments: a normal, or non-resistant strain of houseflies, Musca domestica L., a pyrethrum-piperonyl butoxide-resistant strain of houseflies; adult fresh flies, Sarcophaga crassifasciata, and adult American cockroaches, Periplaneta americana L. When piperonyl butoxide and Allethrin in the ratio of 1:1 are applied to the housefly there is a resultant slight decrease in the rate of Allethrin penetration and initial lag in knock-down time. C\textsuperscript{4}L-labelled pyrethrum and citrusin were found useful in this investigation. In general, the various experiments showed that piperonyl butoxide reduces the rate of denitration of pyrethrin and citrusin in vivo.


The fate of pyrethroid insecticide in female DDT-resistant houseflies (Musca domestica L.) has been studied, using Allethrin labelled with C\textsuperscript{4}L on the chrysanthemum monocarboxylic acid moiety. To study the
absorption and excretion of Allethin or its degradation products quantitatively, a method was devised for attaching house flies in stationary positions throughout the experimental period. Allethin was rapidly absorbed, metabolized, and excreted. The synergist piperonyl butoxide applied jointly with Allethin at a 1:1 ratio retarded both absorption and excretion of the labelled insecticide. Almost all the absorbed dose of Allethin was metabolized by houseflies in 24 h. The bulk of the radioactivity present in the homogenate and excreta behaved as an unknown metabolite, only trace amounts of unchanged Allethin or free acids being detected. No qualitative differences in the metabolism of Allethin applied alone or jointly with piperonyl butoxide were found in these experiments. (auth. summary)


Young pyrethrum plants having numerous buds were grown for 12 d in an atmosphere containing 68 μc of C"<sup>14</sup>CO<sub>2</sub>/mg total C. The ligroin extract from the flowers was strongly radioactive. (CA 62: 8465a, 1965)


Pyrethrine are obtained from pyrethrum flowers (Chrysanthemum cineraricefolium). Although the plants will grow in any part of the world, it has been observed that the flowers contain an appreciable amount of pyrethrine only when cultivated at high altitudes with temperate-climates. Pyrethrine are substances of strong insecticidal actions but are completely non-toxic to warm-blooded animals and to man. The use of pyrethrine as insecticides is growing since insects develop no resistance to pyrethrine as they do to synthetic insecticides. The preparation of radioactive pyrethrine extract is reported following exposure of plants to an atmosphere containing carbon dioxide labelled with C"<sup>14</sup>. (NSA 13, 8357, 1959)

Pellegriini, J. P., Jr., Miller, A. C., Sharpless, R. V. BIOSYNTHESIS OF RADIOACTIVE PYRETHRIN USING C"<sup>14</sup>CO<sub>2</sub>. J. econ. Ent. 45, 3 (1952) 582-6.

A method is described for obtaining radioactive pyrethrine by growing pyrethrum plants (Chrysanthemum cineraricefolium) for a prolonged period in an atmosphere containing radioactive carbon dioxide (C"<sup>14</sup>CO<sub>2</sub>) and isolating and purifying the pyrethrine from the C"<sup>14</sup>-labelled flowers. A mixture of C"<sup>14</sup>CO<sub>2</sub> and normal carbon dioxide (C<sub>14</sub>CO<sub>2</sub>) was generated from a mixture of radioactive and normal barium carbonates (BaC<sub>14</sub>CO<sub>3</sub> and BaC<sub>12</sub>CO<sub>3</sub>) and their utilization by the plant described. The method is given in some detail. About 400 mg pure pyrethrine were extracted from the flowers. Tests showed that the pyrethrine had the expected insecticidal activity against houseflies (Musca domestica L.) and cockroaches, and that they were labelled with C"<sup>14</sup> in both alcohol and acid portions of the molecules at levels high enough for qualitative and quantitative determinations. Detailed observations made throughout the week, precautions taken and improvements that could be made in the method are discussed. (From RAE-A 40; 449, 1952)


As an aid to study of the mode of action of piperonyl butoxide, a pyrethrum synergist, radioactive piperonyl butoxide was prepared. A study was made of the absorption and excretion of radioactive piperonyl butoxide after its topical application to the ventral thoracic area of males and females of Leucophaea maderae (F.). About 95% was absorbed in 3 d. About half the radioactivity in the applied dose was recovered from the faces in 7 d. Paper chromatographic analysis of facial extracts showed that less than half of the radioactivity was from piperonyl butoxide; the remainder consisted of unidentified, water soluble metabolites. The internal distribution of radioactivity in female cockroaches showed that the brain and thoracic ganglia, fore-gut, hind-gut and Malpighian tubules contained the greatest amounts of radioactivity per unit weight. Since little radioactivity was found in the other tissues, it is postulated that the nervous tissue, fore-gut, hind-gut and Malpighian tubules are involved in the breakdown of radioactive piperonyl butoxide in females of L. maderae. (from auth. summary)

(An abstract of this paper was published in Iowa State Coll. J. Sci. 32, 2 (1957) 159-60. See also Bull. ent. Soc. Amer. 2, 3 (1956) 17, abstr. 22)


II - F Nicotine

Bennett, D. R., Teedoechi, R. E. VI. OBSERVATIONS ON THE Pharmacodynamics. 98 (1954) 221-7

Isotopically labelled nicotine was administered to rabbits. The nicotine isolated had a specific activity of 1-10 mg/kg of C<sup>14</sup>-labelled nicotine, with no proof of storage in the viscera.

Bowden, K. BIOGENESIS OF NON
Abstract of doctoral thesis. See also Schmidt and Dahm, 1956.


For the purpose of studying the metabolic fate of C14-labelled insecticides of the pyrethrin type a method was applied which separated the esters and their acid and alcohol products of hydrolysis. These had to be separated under conditions unfavourable to their further decomposition after extraction from insect tissue or other, on unidimensional paper chromatograms so that they could be assayed radiochemically by scanning techniques. The method of reversed phase paper chromatography developed for the separation of bromine analogues of DDT and its derivatives was found to be applicable, with minor modifications.


A natural mixture of (biosynthetically) C14-labelled pyrethroids were resolved by reversed-phase paper chromatography into chrysanthemic and pyrethric esters, and unidentified non-insecticidal impurities. Allethrin, labelled with C14 in the alcohol portion of the molecule, was prepared on the millimole scale at a specific activity of about 60 μc/g of pure ester and purifed by means of reversed-phase paper chromatography. Allethrin, the natural mixture of pyrethroids, or the chrysanthemic esters separated chromatographically was injected into or applied topically to adult houseflies. After a metabolism period the unchanged esters and their metabolites were extracted, resolved by paper chromatography and determined by radioactivity assay. Significant and comparable fractions of all the applied pyrethroids were metabolized to relatively non-insecticidal substances within 48 h. When the synergist piperonyl cyclone was applied simultaneously with the pyrethroid, the metabolism was substantially inhibited, but least effectively in the case of Allethrin. Absorption of the pyrethroids applied topically was almost complete within 54 h and was apparently non-selective from an applied mixture of esters. The presence of piperonyl cyclone inevitably retarded absorption in 24 h, presumably by dilution of the pyrethroid on the insect integument. (from auth. summary)


The tissue distribution and metabolism of C14-labelled pyrethrin and cinetox in the American cockroach, Periplaneta americana (L.), were determined in male and female roaches, and the data summarized in tabular form. A rather extensive distribution of the insecticides or their metabolites is implied. A comparison was also made of the conversion of pyrethrin and cinetox to C14O2 following administration to both sexes by several routes. The highest percentage of excreted C14O2 (measured as 14CO2) occurred after intraspinular perfusion. Results are presented as tables and graphs. A large portion of the radioactive pyrethrin and cinetox may be taken to have undergone hydrolysis in the insect to corresponding into-alcohols and chrysanthemum acids, plus unchanged esters, and several unidentified metabolites. Eight to 12% of the radioactivity was excreted as C14O2.

(Also published as AECU-2411, Kansas Agricultural experimental Station, 49 p.)

II - F Nitocine, Carbamates and other Compounds

Nicotine


Isotopically labelled nicotine was obtained from tobacco plants grown in an atmosphere containing C14O2. The nicotine isolated had a specific activity of 0.187 μc/mg. After the intravenous injection of 1-10 mg/kg of C14-labelled nicotine into dogs, 95% appeared in the urine within 24 h. There appears to be no prolonged storage of nicotine or its metabolites in body tissues. No radioactivity was detected in the expired air.

682 Bowden, K. \ BIOGENESIS OF NICOTINE. Nature 172 (1953) 768.
DL-Tryptophane, containing C\(^{14}\) in the \(\beta\)-position, was fed as its acetate to young tobacco plants via the roots. The leaves became radioactive. The nicotine from the plant was separated from other products. The spots obtained chromatographically were found to exhibit no radioactivity, the results so far obtained leading no support to the theory that the tryptophane molecule in 

\(\text{CH}_3\text{COONa} \rightarrow \text{CH}_3\text{CONH}_2 \rightarrow \text{CH}_3\text{COO}^- \rightarrow \text{CH}_3\text{COO}^- \rightarrow \text{C}_8\text{H}_7\text{N}_2\text{O}_2\)

was converted into nicotine.


Tracer experiments with C\(^{14}\) have established that the methyl carbon of methionine can act as a precursor of the nicotine methyl carbon in tobacco. Nicotiana rustica plants. A lesser incorporation of formate carbon into the methyl group of nicotine was observed. It is considered probable that formate is employed by the plant in the synthesis of labile methyl groups, which then undergo transmethylation to nicotine. (auth.)


Tracer studies with C\(^{14}\) showed that the methyl carbons of choline can be transferred to give the methyl group of nicotine in N. rustica. The methyl carbons of choline and methionine were donated to nicotine at about the same rate. No phospholipids could be isolated from the growing tobacco plants by the method employed, and it was concluded, therefore, that no significant amount of choline was involved in the synthesis of phospholipids. (auth., summary)


In order to ascertain the possible metabolic origin of the N-methyl group of nicotine, each of 30 tobacco plants, 3-month-old, was fed 1.24 \times 10^{-7} moles of glycine labelled with C\(^{14}\) in the alpha-carbon and having a radioactivity of 1.0 \times 10^6 cpm. After the desired feeding period, the plants were dried and nicotine isolated from them as the diacetae. From a group of plants supplied glycine for 10 d nicotine dipicrate having a specific activity of 11.6 \times 10^6 cpm/mg was obtained whereas another group of plants to which glycine was fed for 7 d yielded nicotine dipicrate with a specific activity of 8.5 \times 10^6 cpm/mg. The nicotine from both groups of plants was demethylated using hydroiodic acid to discover how much of the radioactivity was in the N-methyl carbon. The methyl iodide formed upon demethylation of the nicotine was reacted with triethylamine to give methyltriethylammonium iodide which was counted for radioactivity. About 70% of the radioactivity of the nicotine from plants fed glycine for 10 d was recovered in the quaternary iodide whereas the nicotine from plants fed glycine for 7 d yielded about 100% of the radioactive carbon on demethylation. Glycine labelled with C\(^{14}\) in the carbonyl carbon when fed to tobacco plants under the same conditions did not give rise to radioactive nicotine. (auth.)


Previous studies in our laboratory have indicated that in tobacco plant metabolism an N-methyl group of nicotine may arise from formaldehyde and from methionine or by the acetylation of nicotine or by the deamination of glycine. In a comparative study it was found that, in one week, the alpha-carbon of glycine was incorporated to a greater extent than any of the other methyl group precursors used. In the present work C\(^{14}\) formaldehyde and serine labelled with C\(^{14}\) in the beta-position have been administered to tobacco plants in an effort to ascertain other precursors of the nicotine methyl group. Nicotine isolated from plants fed these compounds was radioactive, and demethylation showed that the radioactivity was located almost entirely in the N-methyl group. It was further demonstrated that formaldehyde was incorporated into methyl groups to a greater extent than alpha-carbon of glycine in one week, whereas the beta-carbon of serine was introduced to a lesser extent. These results suggest that the alpha-carbon of glycine and the beta-carbon of serine may be converted either to formaldehyde or an 'active' formaldehyde which is then reduced to the methyl group of nicotine.


Nicotinic acid had (elsewhere) been regarded as a possible precursor of the pyridine moiety of the Nicotiana alkaloids. An isotopic test was devised for checking on the availability of nicotinic acid and its ethyl esters as precursors for nicotine biosynthesis. Carboxyl-labelled nicotinic acid was prepared from 8-bromo-tpyridine, g-butyllithium and C\(^{14}\)O\(_2\). It was fed in a mixture of 0.5 \mu\text{g/mg} C was added to the culture and in the course gave rise from C\(^{14}\) feeding experiments to nicotinic acid nor to its ethyl ester are discussed. It appears that plant is confined to the culture.


Ring-labelled H\(^{3}\) and C\(^{14}\)-labelled H\(^{2}\) and C\(^{14}\)-labelled H\(^{3}\) in the Brookhaven pile. The nicotine produced by these plants had a degradation experiment demonstrated that nicotine is thus produced from specifically labelled nicotinic acid.


Ring-labelled H\(^{3}\)-nicotinic acid was supplied to sterile cultures of N. tabacum. The H\(^{3}\)-nicotinic acid showed no detectable radioactivity, but the C\(^{14}\)-nicotinic acid showed a peak at 2700 cpm. Conclusions: the pyridine ring and related alkaloids. (CA 1966)


The four specific ring hydrogens of the nicotine, the nicotine acid-14 labelled nicotinic acid-6-\text{H} show similar and specific from the nicotine, to the conversion of the nicotinic acid during its conversion. Incorporation shown by the oxidation of the acid is required to be a, but not a, a, \(1,6\)-dihydro intermediate is extent as the conversion of nicotine.

Dawson, R.F. BIOSYNTHESIS.

The author discusses the tocopherol production and the possible nature of some growth factors, and specifically stimulated growth and radioactivity was found to cause others results indicate that nicotine universal metabolites nicotine and the some modification prior to retention of the terminal products from such a process. }
of nicotine can act as a precursor of nicotine, which is then converted to nicotine.

The metabolism of nicotine involves several steps, including demethylation and hydroxylation. The resulting metabolites can be further transformed into nicotine or other compounds.

The biosynthesis of nicotine involves the conversion of precursors into nicotine through a series of enzymatic reactions. The exact pathway is not fully understood, but it is known that nicotine is synthesized from simpler precursors, such as nicotinic acid and amino acids.

Ring-labelled T-nicotinic acid and nicotine were used in experiments to study the incorporation of carbon into nicotine. The results showed that nicotine is synthesized from a precursor that contains 14C.

The biosynthesis of nicotine from nicotine itself is a complex process involving multiple enzymes and metabolic pathways. The exact details of this process are still being studied, but it is clear that nicotine is synthesized from simpler precursors through a series of enzymatic reactions.

The study of nicotine metabolism and biosynthesis has important implications for understanding the effects of nicotine on the body and the development of smoking habit. It also provides insights into the potential for developing new nicotine-based therapies for smoking cessation.


Ring-labelled T-nicotinic acid and C-14 nicotine were used to study the biosynthesis of nicotine. The results showed that nicotine is synthesized from a precursor that contains 14C.

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The metabolism of nicotine has been studied in various contexts.


Radioactive nicotine was isolated from tobacco plants and three weeks after the administration of the nicotine to the plants, it was degraded to the two α-carnons of the nicotine.


Nicotiana tabacum plants were grown in a radioactive nicotine solution. The incorporation of nicotine into the plant was monitored and compared with non-radioactive nicotine. The results showed that the incorporation of nicotine into the plant was significantly lower in the radioactive nicotine experiments.


Isolated root cultures of tobacco were used in the biosynthesis experiments. The results showed that the incorporation of radioactive nicotine into the plant was significantly lower in the radioactive nicotine experiments than in the non-radioactive nicotine experiments.


The compound was absorbed through the descending order of absorption rates and was absorbed through the roots of the plant.

Eldesawi, M. E., Heslot, W. J. RESISTANT HOUSE FLIES. Bio-

Topical application of nicotine and paper electrosprays at low currents were used to study the resistance to nicotine.


A study of the absorption of nicotine from soil by mice showed that the absorption of nicotine from soil is significantly lower than the absorption of nicotine from non-radioactive nicotine experiments.


A study of the absorption of nicotine from soil by mice showed that the absorption of nicotine from soil is significantly lower than the absorption of nicotine from non-radioactive nicotine experiments.
ETHYL GROUP OF NICOTINE THROUGH
13 C and deuterium, was administered to the plant, and its methyl group can give rise to the methyl

PYRROLIDINE RING OF NICOTINE.

shows incorporation of pyrrolidine into the ring as of the radioactive precursors of the pyrrolidine ring. Therefore, the pyrrolidine ring. The remaining ring. The α-C atom of the pyrrolidine ring was a 1950.

INACTIVE NICOTINE. Bot. Gaz. 119

The metabolism of nicotine-C14 into nicotine-producing Nicotiana tabacum and in anabasine-producing Nicotiana glauca has been studied. The nicotine isolated from the plant was inactive, but the anabasine was radioactive. Systematic degradation of the anabasine into nicotine and the pyrroline ring indicated that all the radioactive nitrogen was in the α-carbon atom of the pyrroline ring. The significance of these results is discussed. (Auth.)


Radioactive nicotine was isolated from two groups of Nicotiana tabacum plants, which were harvested one and three weeks after the administration of equal amounts of ornithine-2-C14. The nicotine from the two experiments had almost the same specific activity, indicating that little or no metabolic breakdown of nicotine had occurred during the last two weeks of the second experiment. The nicotine from both experiments was degraded unambiguously and all the activity in the alkaloid was shown to be equally divided between the two α-carbons of the pyrrolidine ring. (Auth.)


Nicotiana tabacum plants were grown for varying length of time up to 3 weeks after feeding ornithine-2-C14 to the roots of the plant. The activity of the nicotine reached a maximum after 3 weeks and then slowly decreased. When glutamic acid-2-C14, uniformly labelled proline-C14, and putrescine-1,4-C14 were fed to the plant, radioactive nicotine was obtained in each case. Degradation of the nicotine from these experiments showed that all the activity occurred in the pyrrolidine ring. Under similar conditions the incorporation of ornithine, putrescine, proline, and glutamic acid into nicotine was 0.48, 0.12, 0.632, and 0.0076%, respectively. The significance of the results is discussed. (CA 29: 13022a, 1958)


Isolated root cultures of tobacco were fed with compounds labelled with C14. Chemical transformations involved in the biosynthesis and degradation of nicotine were studied. Reaction mechanisms are discussed. Results are compared with those previously reported. (NSA 15: 10951, 1965)

Carbamates


The compound was absorbed through the cut surface of leaves, cut surfaces of roots, and intact roots (in descending order of absorption rate). Leaf surfaces did not absorb it in appreciable amounts. The absorption through roots was greater in corn plants than in oat plants. (CA 64: 770b, 1966)


Topical application of C14-Sevin results in rapid absorption and excretion. By use of paper chromatography and paper electrophoresis, at least three metabolites are demonstrated in both tissues and excreta after four hours. Susceptible and resistant strains show differences in amount and proportion of the metabolites.


A study of the absorption of radioactive EPTC by crops in pre-emergence application indicated an uptake of this chemical from soil. By use of a radiometric technique the differences in accumulation patterns of 35S from EPTC-54 among crops were demonstrated; above-ground portions of beans, peas, and corn
contained slightly more sulfur-38 than the roots, while above-ground portions of radishes, carrots, and other plants contained 70 to 94% of the S38 from the absorbed EPTC-338. Total absorption by individual crops at various stages of growth was determined. Generally, an increase in applied EPTC-338 increased absorption, but not in proportion to the increase in the rate of application. (Auth.)

706

The commercial introduction of Sevin as a broad spectrum insecticide of low mammalian toxicity has created interest in the study of the mechanism of its insecticidal action and its metabolism in insects. A convenient synthesis of C14-labeled material is described to provide a tool for these studies at normal dose levels. (Auth.)

Other Compounds

707

Newly emerged flies were placed on standard corn meal-molasses food to which tracer amounts of P14 and 2,4-dinitrophenol (0.0005 M, 0.0005 M and 0.001 M) were added. Females were dissected after varying intervals; the amount of P14 taken up by various tissues was determined. Initially, most of the phosphorus is found in the gut and hemolymph; later, the ovaries and thorax have the highest percentage. Although females fed 0.0005 M and 0.001 M DNP incorporate less phosphorus, the distribution of phosphorus within the body appears normal if ovarian growth is comparable to that of the controls. However, ova from flies fed DNP seem to mature more slowly than ova from controls. Upon being removed to unlabeled food, control females excrete phosphorus more rapidly. Thus, it is concluded that both phosphorus uptake and turnover are reduced in the presence of 0.0005 M and 0.001 M DNP.

(Received for publication August 1957, revised December 1957)

708

A radioactive retinene, C14 in position on (CH3)2C, in two compounds C14HCOONa and in both was used as precursor of retinene. It could be shown that both carbon atoms are incorporated in retinene in barbados plants, that the acetate can be sterilized by means of fallow absorption, and that the method described is an easy way of preparing radioactive retinene.

709

The effects of dinitrophenol (DNP) on phosphorylation have been studied in the isolated rat diaphragm. Three concentrations of DNP were used: one which stimulated respiration, a higher one which gave stimulation followed by depression, and a still higher one which gave principally profound depression. With all concentrations of DNP, phosphocreatine was completely hydrolysed and the concentration of adenine triphosphate (ATP) was reduced markedly. The concentration of hexose monophosphate (HMP) was reduced when respiration was depressed. The turnover rate of ATP was not affected by a concentration of DNP which stimulated respiration, but was decreased by the high concentrations which depressed respiration. The turnover of HMP was increased by the stimulating concentration and not reduced below the control level by the higher concentrations of DNP. This suggests that there are pathways for the formation of HMP in the intact cell which are resistant to DNP and therefore different from those found in particular fractions. 14C was used as tracer element throughout. (From auth.)

710

Turell, F.M. PHYSIOLOGICAL EFFECTS OF ELEMENTAL SULFUR DUST ON CITRUS FRUITS. Plant Physiol. 25 (1950) 12-42.
Rate of volatilization of elemental 3 increased logarithmically with temperature. 3S dusted on lemon trees caused the peak to a depth of 540 μ when the fruit was incubated 6 h at 12.6°C. The release of gases, specifically of H2S and SO2, under different conditions (acidic, anaerobic, while incubated at different temperatures) is discussed. C教室 of the peak was assimilated by dust treatment and incubation. 3S dusted fruits in comparison with non-dusted had higher SO2 in the peel and sap; there was more SO2 in the peel of fruits burned on the tree; there was more on the burned side than on the unburned.

711

Turell, F.M., Cherenack, M. LEMONS AS AN INSECTICIDE. (For detailed abstract, see CA 45, 12504.)
When lemon fruit is dusted with the P in the H2S formed is derived similarly provided large a source within the plant. Element produced by topcal dust. The element which vaporization occurs and the lemons suggest that the S has been

712

Wilson, L.P., King, R.C. STABILITY OF DNP ON PHOSPHORUS INCORPORATION (1955) 36-82.
A study was made of the effect of the adult Drosophila melanogaster, normal phosphorus metabolism when 0.001 M DNP than males. The flies was 1 x 10-6 mg DNP/mg wet male and female flies; the reduced to release the rate at which exoglut, Malpighian tubes, ring, a block exogenous phosphorus uptake. Consumption of P incorporation is a fact that DNP-treated female phosphorus is not absorbed. Per unit weight the of control females incorporates 0.5 h period. Per unit weight their and thiones. It was found that the phosphorus entering the system 1959.

713

Phosphoric acid was used as on citrus blood. When dietary mosquitos were exposed to the into the blood. When the coned into, those that did not feel of them inserted their proboscis. Repellency was due to vapors acid as been involved. (Auth.)

714

Green, N. SYNTHESIS OF CA REPPELLENT. J. econ. Ent. 51. For studies of the various proper repellent, this compound was pr position by synthesizing m-toluic acid. The reaction was then conducted activity was 8.7 x 107 dinitom.
1-CARBON-14 [N-METHYLGLUCAMATE],

the low mammalian toxicity has
on and its metabolism in insects. A
for these studies at normal dose

NITROPHENOL UPON THE UPTAKE, LOCALI-
SCUTA FEMALES. Genetics 41 (1949) 309,

to which tracer amounts of CO2 and
females were dissected after varying
. Initially, most of the phosphorus
the highest percentage. Although
the distribution of phosphorus within
controls. However, ovariates from
Upon being removed to unlabelled
concluded that both phosphorus uptake

NITY, p. 225-8 in "Radioisotopes in the Peaceful Application of Nuclear

COON) and in both was used as
incorporated in lomone in barbadosca-
and that the method described

THE TURNOVER OF THE ACID-
mg, 30 (1950) 206-18.

In the isolated rat diaphragm. Three
higher one which gave initial
principally profound depression. With
and the concentration of adenonine
monophosphate (AMP) was reduced
measured by a concentration of DNP which
the AMP level below the control level
ways for the formation of HMP in the
be found in particular fractions. **

ON CITRUS FRUITS. Plant Physiol.

temperature, 59° on lemon fruit
h at 15.6°C. The release of gases,
aseboic, when incubated at different
at treatment and incubation. S-dusted
there was more SO2 in the peel of
unburned.

(For detailed abstract, see CA 44: 3646b, 1950)


When lemon fruit is dusted with sulfur containing 35S and incubated (41.1°C for 88 h), a large proportion of the S in the H2S formed is derived from the S applied. The sulfate formed in the fruit peel can also be derived similarly provided large amounts of S are applied, whereas the SO2 formed is derived largely from a source within the plant. Elemental S-vapor penetrates lemons producing compounds similar to those produced by topical dust. The quantity of S-products formed is influenced by the area of the S-layer from which vaporization occurs and the duration of the exposure at 41.1°C. Radiographs of the peel of dusted lemons suggest that the S has been incorporated into the tissue proteins.


A study was made of the effect of dinitrophosphor upon viability, growth, and phosphorus incorporation by adult Drosophila melanogaster. Results are tabulated and presented graphically. Data are included on normal phosphorus metabolism in Drosophila. Adult females were found less susceptible to toxic effects of 0.001 M DNP than males. The minimum value for the ingested amount of DNP toxic to male and female flies is 1 x 10^-5 mg DNP/mg wet weight fly. DNP reduces the rate at which exogenous P is incorporated into male and female flies; the reduction is more marked in females. The general action of DNP in females is to reduce the rate at which exogenous phosphorus is incorporated into the haemolymph, thorax, head, legs, gut, Malpighian tubes, wings, and abdominal residue. DNP acts specifically on the ovary to completely block exogenous phosphorus uptake after an exogenous P-concentration 20% of the control value is reached.

Cessation of P incorporation is accompanied by a cessation of ovarian growth, which partially accounts for the fact that DNP-treated females do not increase in weight at the control rate. Per unit weight the ovary of control females incorporates 1.7 times as much exogenous phosphorus as the testis of control males in a 30 h period. Per unit weight there is no sexual dimorphism in exogenous P incorporation by control heads and thoraces. It was found that over a wide range of incorporated exogenous P-concentrations 75-80% of the phosphorus entering the haemolymph is withdrawn rapidly by the various tissues. (From BA 30: 28774, 1980)

II - G Repellents

Diethyltoluamide


P32-phosphoric acid was used as a tracer in experiments with Aedes aegypti (L.) feeding through a membrane on citrated blood. When diethydtoluamide was present in the blood at a concentration that prevented the mosquitoes from engaging, the mosquitoes barely touched the membrane and did not insert their proboscises into the blood. When the concentration was lowered to one that allowed about half the mosquitoes to become engorged, those that did not feed spent slightly more time in contact with the membrane, and about a third of them inserted their proboscises into the blood but did not imbibe. It was concluded that most of the repellency was due to vapour action, but at a low concentration contact chemoreceptors on the labelia may have been involved. (Auth.)


For studies of the various properties of N, N-diethyl-m-toluamide, an outstanding all-purpose insect repellent, this compound was prepared in radioactive form. The molecule was labelled to the carboxy position by carbonating m-toluene magnesium bromide with C14O2 to give C14-m-toluic acid. The m-toluic acid chloride was then combined with diethydtoluamide to give the final product, of which the specific activity was 5.7 x 106 disintegrations per second per gram. (Auth.)

Little information is available as to why certain compounds act as insect repellents, and why they are effective for such short periods of time. Diethyltoluamide labelled with C$^{14}$ was applied to the skin of guinea pigs at 6.97 - 7.11 mg/in$^2$. After 6 h 0.06 - 0.08 mg/in$^2$ had been lost by evaporation and 1.92 - 3.60 mg/in$^2$ by absorption. The remaining repellent was removed. The radioactivity in the urine reached a peak within 12 h after application, and over 80% of the absorbed dose was excreted in 24 h. However, diethyltoluamide as such was not found in the urine. Only 0.75% of the absorbed dose was excreted in the faeces during 8 d, whereas 93% appeared in the urine. Very small amounts of radioactivity were found in the blood, skin, and hair. (from auth.)

(An abstract of earlier work was published in Bull. ent. Soc. Amer. 4, 3 (1958) 96, abstr. 188)

Dimethyl Phthalate


C$^{14}$-labelled dimethyl phthalate was prepared by treating 2-McC$_3$H$_7$H$_4$MgBr with C$^{14}$O$_2$ (obtained from BaC$^{14}$O$_3$), oxidizing the resulting p-toluate acid to phthalic acid, and esterifying by the acid chloride. The over-all yield, calculated on BaC$^{14}$O$_3$, was 80.4%. (CA 49: 7185c, 1955)


The retention of NaI, MeI, and dimethyl phthalate (D) on the skin in various ointment bases was studied under 3 experimental conditions (normal, exposure to a fine spray of H$_2$O, and conditions of teatment (pulp needle) with radioactive tracer techniques. Under normal conditions, an oil/water base gave better retention for NaI and MeI than a water/oil base, but the reverse held true when the bases were subjected to fine H$_2$O sprays. Under conditions of penetration, NaI was retained well in water/oil base but MeI was retained better in the oil/water base. A water/oil emulsion containing 40% D provided better retention under all conditions. On the basis of the data obtained, an improved cream containing 15% of acetoacetin was evaluated and found superior to 7 other bases. (CA 49: 163101, 1955)

II - H Insecticide Metabolism in II-H-1 INSECTS

Surveys


Review article dealing with resistance to DDT, Propan, Dieldrin, BHC, organophosphorus insecticides, pyrethrin, cyanide, and arsenic. 229 references. Work with radioisotopes is included but not emphasized.


After sketching the main lines of interest in insecticide research, the author considers general detoxication mechanisms. A section on chlorinated hydroarbons is divided into DDT metabolism in houseflies, DDT-dehydrochlorinase of resistant houseflies, synergists for DDT-resistant flies, DDT metabolism in insect other than houseflies, hexachlorocyclohexane (BHC) metabolism in houseflies, and insect metabolism of cyclodiene insecticides. A shorter section deals with pyrethroids and miscellaneous insecticides. Organophosphorus insecticides are discussed in terms of their oxidation reactions, reactions other than oxidation and phosphoryl or allyl phosphate hydrolysis, phosphoryl and allyl phosphate hydrolysis, their selectivity in relation to the metabolism of organophosphorus insecticides and acquired resistance to them. Relevant work with radioisotopes is cited throughout.


Some of the advances in insect control techniques are discussed. The limitations are indicated. (18)

21 Kears, C. W. BIOCHEMICAL RESISTANCE TO INSECTICIDES. Symposium, vol. 175p.

A review of recent advances in insecticide resistance and of improved methods of detecting resistance.ting (18)


A general survey paper, with some intersting insights into some of the problems of insecticide resistance. (18)

* Metcalf 1960 - [413]

* O'Brien 1959 - [509]

* Perry 1958 - [430]

* Perry 1960 - [431]


Review article with 79 references. Some compounds are metabolised by oxidative reactions such as oxidation reactions, such as N-acylations and sulfones, and oxidative reactions may convert insecticides to non-toxic derivatives. (18)

Winteringham and Barnes 1959 - [224]


The complexity of oxidative and amino acid metabolism of insect by the injection of acetate is discussed. The biochemical significance of the complexity of metabolism is considered. (18)


(Prepared at the Seminar on Insecticide Metabolism, 1958)
Some of the advances in insecticide metabolism studies that have occurred through the use of radioactively tagged insecticides, e.g., DDT, are reviewed. The advantages of such methods as well as the limitations are indicated. (18 references).

A review of recent advances in the biochemistry of the action of toxicants to insects and of their enzymatic detoxification, and of knowledge gained concerning the metabolism of both resistant and susceptible insects.

A general survey paper, with some mention of how the use of radioisotopes in specific cases has given new insight into some of the problems involved.

Review article with 78 references. Most chlorinated hydrocarbon insecticides and many organophosphorus compounds are metabolized by insect species, the metabolic processes which bring about these chemical changes being classifiable as "activating" and "detoxifying". Activating mechanisms usually involve epoxidation reactions, such as conversion of heptachlor to heptachlor epoxide and Aldrin to Dieldrin, or oxidation reactions, such as conversion of thionophosphates to phosphates, oxidation of thiols ethin to sulfur oxides and sulfones, and oxidation of phosphorodiamides to more potent cholinesterase inhibitors. Detoxifying processes may convert insecticide to nontoxic metabolites, which are retained in the tissues or rapidly excreted. Detoxication of organophosphorus compounds in most cases involves hydrolytic reactions. The type of change is dependent on the chemical structure of the compound and the insect species - DDT is metabolized by the housefly, body louse, certain mosquitoes, American roach, Mexican bean beetle, boil weevil, mildewed bog, fruit fly, etc., but this process follows four or five metabolic pathways. Many of these reactions are enzymatically catalyzed. Work with radioisotopes is discussed in connection with C\textsuperscript{14}, Cl\textsuperscript{35} and S\textsuperscript{35} labelled Dieldrin, a B\textsuperscript{12} analogue of Dieldrin, Cl\textsuperscript{14} labelled Aldrin, Pyrethrin, Allethrin and labelled \(\alpha\)-, \(\beta\)- and \(\delta\)-BHC, and P\textsuperscript{32} labelled Malathion, Dipel, DDVP and Delnav.

724 Winteringham and Barnes 1955 - [433]

The complexity of selective (insecticidal) action and biochemical selectivity is reviewed. Glycolysis, oxidative and amino acid metabolism in insects and mammals, the metabolism of acetate (traced in the insect by the injection of acetate-2-C\textsuperscript{14}), and the chemical identity of the metabolites are discussed. In considering the biochemical differences between insects and mammals, variations in enzyme vulnerability under different conditions must be taken into account (e.g., insect enzymes at different stages of insect development). Resistance, physiological differences between insects and mammals, and comparative mechanisms of insecticidal action are discussed.

(Submitted at the Seminar on "The Resistance of Insects to Insecticides" New Delhi, India Feb. 27-March 7, 1958)
Review article. The author discusses identification of the resistance mechanism (reduced uptake or absorption of the insecticide, detoxification or excretion of the insecticide so that the rate of arrival at the sites of action is below the tolerance threshold, abnormal biochemistry or physiology at the sites of action) and possible countermeasures based on biochemical studies. (52 references, including numerous refs. on application of radionuclides)

* Aldrin and Dieldrin

* Chang and Kearns 1959 - [494]

* Waddington and Harrison 1960 - [495],[497]

Bayer 22408


P² labelled Bayer 22408 (O,O-diethyl O-napthalimido phosphorothioate) was converted to the oxygen analogue, O-diethyl phosphoric, O,O-diethyl phosphoric, O,O-diethyl phosphorothioic acid and at least three other metabolites by rats, several species of insects, and cotton plants. Differences in the degradation of Bayer 22408 by the three biological systems were not the result of the number of metabolites but of the amount of each metabolite formed. Bayer 22408 was stable in insects and most of the absorbed material was recovered as administered; the oxygen analogue was formed to a limited extent. Rat degraded Bayer 22408 rapidly to water-soluble phosphoric acids, which were eliminated primarily in the urine. Some Bayer 22408 escaped degradation and was eliminated intact in the feces. Bayer 22408 was not effective as an animal systemic against several ectoparasites feeding on treated rabbits. Bayer 22408 was quite stable on the foliage of cotton plants but was not translocated to untreated portions of plants. (auth.)

BHC

* Bradbury et al. 1953 - [440]

* Bradbury and Standen 1955 - [441]

* * 1956 - [442],[443]

* Bradbury 1957 - [439]

* Bradbury and Standen 1958 - [444]

* * 1958 - [445]

* Bridges 1959 - [446]

* Perlowagocia-smirnovica 1953 - [456]

Chlorobenzene

* Geesner and Smith 1960 - [457],[458]

* Kikil and Smith 1958 - [459]

Co-Sal

Vickery and Arthur 1960 - [519]

Delonav

* Arthur and Castilla 1960 - [500]

Diasinox

* Krueger et al. 1960 - [541]

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Iyazumi et al. 1967 - [527]

Wadlington, F.W., Harris PHOSPHOROFLUORIDATE POISONING.

A considerable reduction in the lethality of DFP is reported. The stimulus in addition to that of the fact that massive doses of DFP act rapidly from the stimulated receptors is caused by the typical paralysis. The same paralysis is caused by inhibited mammalian nerve tissue, otherwise lethal doses of DFP.

* Burns et al. 1959 - [464]

* Giulianii et al. 1959 - [466]

* Hagley and Morrison 1959 - [467]

* Hoffman et al. 1961 - [469]

* * 1953 - [470]

* Hopkins and Witt 1958 - [471]

* LeRoux and Morrison 1956 - [472]

* Lindquist et al. 1951 - [478]

* Lindquist and Dahn 1956 - [479]

* Morrison and LeRoux 1954 - [480]

* Perry et al. 1955 - [481]

* Perry and Buckner 1958 - [482]

* Robbins and Dahn 1955 - [483]

* Roth and Lindquist 1953 - [484]

* Schmidt and Weidhaas 1959 - [485]

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Terielle, L.C., Schorbrod, R. TREATED WITH CARBON14

The study was aimed to investigate the previous authors concerning the effects of the susceptible houseflies had treatment with radioactive insulin up to 80% of the dose in the feces and excretion capacity. The compound is excreted rapidly and has several possible acidic in nature. The effects of the absorbed dose have been observed in a number of cases.
A mechanism (reduced uptake or biodegradation) so that the rate of arrival at the site of action is less than the rate of deactivation at the site of action, including numerous refs. on the subject.


A considerable reduction in the rate of $[C^4]$ acetylation of choline by the insect in vivo as the result of DFP poisoning. The stimulated respiration and glutamine accumulation indicate possibly fatal biochemical lesions in addition to that of cholinesterase inhibition in the DFP-poisoned insect. This view is supported by the fact that massive doses of pyridine-3-aldoxime methiodide (PAM) failed to protect the DFP-treated fly from the stimulated respiration and some delayed lethal effect, although it protected the insect from the typical paralysis. The same dose of PAM alone did not have toxic effects on the insect. It is a potent reactivator of inhibited mammalian cholinesterase in vitro and in vivo and will protect mammals from otherwise lethal doses of DFP.

DDT

- Butts et al. 1953 - (464)
- Gjuillil et al. 1952 - (465)
- Hagley and Morrison 1958 - (467)
- Hoffman et al. 1951 - (469)
- 1952 - (470)
- Hoskins and Witt 1958 - (471)
- Lehoux and Morrison 1954 - (474), (475)
- Lindquist et al. 1951 - (478), (479)
- Lindquist and Dahm 1956 - (477)
- Morrison and LeRoux 1954 - (482)
- Perry et al. 1955 - (485)
- Perry and Buckner 1958 - (486)
- Robbins and Dahm 1955 - (487)
- Roth and Lindquist 1953 - (488)
- Schmidt and Welilhaas 1959 - (490)


The study was aimed at investigating the fate of DDT in resistant and susceptible flies. The observations of previous authors concerning the production of a metabolite other than DDE have been confirmed. Resistant and susceptible houseflies have been examined for evidence of metabolism of DDT up to 14 days after treatment with radioactive insecticide. Susceptible flies, given sublethal doses, have been shown to excrete up to 88% of the dose in the form of a water-soluble conjugate. Resistant flies show a similar detoxification and excretion capacity. The excretion begins during the first day after treatment and continues until all of the absorbed dose has been metabolized. The conjugate is hydrolyzable with acid to produce a compound weakly acidic in nature. Attempts to identify this compound have met with no success although several possible structures have been eliminated.

- Welilhaas and Schmidt 1960 - (491)

A comparison was made of the effects of methyl bromide, ethylene dibromide, and ethylene dichloride on P^32-labelled intermediates extracted from the thoracic muscles of houseflies. The slow depletion of phosphoglycerate by the first two chemicals suggested a common inhibition of triose phosphate dehydrogenase; the third resembled lactic acid in their action. Depletion of ATP and arginine phosphatase with methyl bromide indicated a rapid blocking of the phosphorylation of nucleotide acceptor.


A quantitative study is described (see preliminary communication by Winteringham and Hellyer, 1964). Techniques described earlier (W. Winteringham, Bridges and Hellyer, 1959) were used with only minor modifications for P^32-labeling of the soluble intermediates of the adult insect in vivo, and for their extraction. The paper-chromatographic techniques used were very similar to the previous ones. The chemical identity of the labeled fractions is discussed, and details are given of the ages and conditions of the insects used, and of their treatment. Tabulated data are presented on the distribution of soluble phosphates in tissues of the adult insect; the effects of methyl bromide on the distribution of soluble P... in vivo; of the effects of ethylene dichloride vapour and injected lactic acid on the distribution of soluble P... in vivo, and of the effect of methyl bromide on tissue nucleotides of the adult housefly in vivo. The significance of the results are discussed, particularly with regard to changes in ATP-levels.

Malathion

* Darrow and Flapp 1960 - [681]
* March et al. 1956 - [667]
* Mengle et al. 1959 - [668]
* Knegger and O'Brien 1959 - [665]
* Knegger and O'Brien 1959 - [666]

The nature and quantity of hydrolysis products were determined following administration of Paraoxon to mosquito larvae. Chromatographic results indicate differences in detoxification rate between the resistant and normal strains. Additional studies were made with 14C-labelled material attempting to correlate resistance with rate of hydrolysis.

Parathion

* Gar et al. 1954 - [573]
* Lockau et al. 1961 - [581]
* Lockau and Lüdicke 1962 - [582]
* Tomizawa et al. 1960 - [588]

Phorate

* Bowman and Casta 1958 - [590], [591]

Pyrethrin

* Blum and Kears 1956 - [669]
* Bridges 1957 - [670]
* Earle 1962 - [671]
* Hopkins and Robbins 1957 - [672]
* Pellegrini et al. 1952 - [675]
* Schmidt and Dahm 1956 - [676]
* Winteringham 1958 - [679]
* Winteringham et al. 1955 - [679]
* Zeld et al. 1963 - [680]

Rotenol

* Hopkins 1960 - [693]
* Louloudes 1958 - [690]

Schnadan

* Arthur and Casta 1958 - [604]
* David 1950 - [603]
* David 1961 - [603]
* McTavish and March 1953 - [628]
* Pietrz-Tonelli and March 1954 - [628]
Sevin

Systox


Aphids which had been rendered moribund were supplied twice a day for a week as food to the predators in petri dishes. The predators tested were the Syrphids, Baccha clavata (F.), Metasyrphus wiedemann 1 (Johnson) and Alloplaga obliquis (Hay), the Coccinellids, Scymnus hesperocorius Lec., S. cupreus Muls., Hippodamia convergens (Goeze), Cephalonomia (Cephalonomia) maculata (Deg.) and Cycloneda sanguinea (L.), and the Chrysoptes, Chrysopa affinis Rumm., and C. oculata Say. Larvae of all these species and adults of the Coccinellids were used and mortality counts were made daily. The different susceptibilities shown by the results are discussed. In some of the tests, Systox prepared from radioactive sulphur (S^35) was used, and the predators were dried, ground and assayed for radioactivity. The radioactive material apparently accumulated in the bodies of the larvae, since third- and fifth-instar individuals that survived treatment showed 4.26 and 7.29 cpm/mg, as compared with 23.8 and 15.32 for those that were killed, respectively. Adults of H. convergens showed much less radioactivity than larvae when both fed on radioactive aphids, and adults that developed from such larvae showed less than the prepupa; the cost pupal skin showed much more than either. Larvae of Chrysopa oculata that fed for 8 d showed 1.54 cpm/kg, but survived.

David 1957 - [632]

Elder lwai and Gordon 1959 - [633]

Palunto et al. 1955 - [635]

March et al. 1956 - [640]

Tepp


In order to study the fate of organic phosphates in Periplaneta americana (L.), radioactive TEPP and Parathion were dissolved in acetone and administered to adults of both sexes by topical application to the cervical membrane or by mouth with a microsyringe. Quantitative data on the concentrations of the compounds in the tissues and blood after various periods were obtained by assay with a counter, and radioautographs were used to study the gross distribution of TEPP after topical application. The method of preparing them, which is suitable for use with compounds soluble in water and in the organic solvents used in the preparation of tissues for microtomy, is described. The distribution and relative concentrations of TEPP, Parathion and Paraaxon in the body of the cockroach are discussed, and also their rate of penetration. The effects of different dosages are described. Blood was found to be the chief medium of transmission of all the compounds in the body.

Roan et al. 1950 - [653]

Miscellaneous


The strains of houseflies compared were the susceptible S-F, derived from NAIDM 1948 stock, and the resistant R-OB, selected for DDT resistance for 143 generations. Fly eggs were added to what amounted to a solution of about 0.135 mc P^32/ml. The culture was maintained in a room held at 26.2°C and 50% relative humidity. The resulting adults were fed, and later extracted by the methods described. It is concluded that housefly larvae are able to utilize inorganic phosphorus to synthesize phosphates of widely differing chemical nature. The radioactive phosphorus decreased rapidly in the adult insects except in the lipid fraction. The biological half life of the radioactive material was 4.7 d for the trichloroacetic acid fraction.

for 8.3 d for the residue, but more supplemented radioisotope to

Benjamin et al. 1959 - [656]

Bertin et al. 1955 - [649]

Bertini and Boocarce 1968 - [717]

Castles 1955 - [659]

Casida, J. E. TOXICITY OF XAND THE COUNTERACTING MECHANISMS OF BENZOTHIAZOLE INsects.
The toxicity of benzothiazole and its counteraction decreased as the

Fredericksen and Lilly 1956 - [721]

Kosbybonsky 1955 - [664]

Meininger, E. C., Casida, J. E. TO ORGANOPHOSPHATE INSECTICIDES.
The metabolic fate of P^32-labeled

Plapp and Castles 1958 - [660]

Schmidt, C. H., Weidhass, D. Distribution of 

Acento-water suspensions of a (O.O-diethyl S-Methyl) was tested against 4th-instar, (Colcidae; Diptera). Consequent

Plapp and Castles 1958 - [660]

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S. d for the residue, but more than 11 d for the lipid fraction. This work emphasizes the necessity for supplementing radiosteric techniques with routine chemical procedures in the study of biological processes.

- **Benjamin et al. 1959** - [856], [857]
- **Bettini et al. 1958** - [499]
- **Bettini and Boccaccio 1958** - [506]
- **Casida 1955** - [859]


The toxicity of benzoic acid to these larvae was reduced in the presence of glycine. The efficiency of this counteraction decreased as the larvae matured, and was greatest at pH 7 or below. The quantitative relationship of the decrease in benzoic acid toxicity in the presence of low glycine concentrations suggested an equimolar detoxication reaction. Benzoic acid was 16 times as toxic as hippuric acid to these larvae. Using (p-C6H4CH3) glycine it was shown that mosquito larvae can synthesize hippuric acid and probably excrete the conjugated product. Thirty amino acids and closely related compounds were tested for their efficiency in reducing the toxicity of benzoic acid. Although glycine was the most efficient amino acid, in its absence many others were capable of reducing the toxicity of benzoic acid. The structural specificity for this counteraction is discussed. The toxicity of 80 aromatic or closely related compounds was determined. The relation of structure to the toxicity and mechanism of action of these acids is discussed. An example is presented for a synergistic action through competition for a common detoxication mechanism. (auth. summary)

- **David 1952** - [751]
- **Fredericksen and Lilly 1955** - [357]
- **Kossobokovsky 1955** - [884]


The metabolic fate of p212-labelled DDT was studied in three housefly strains, two of which were resistant to organophosphates. Rate differences between the strains in cuticle penetration, phosphorylcholine oxidation, or phosphate hydrolysis did not appear to explain the resistance. The lesser in vivo cholinesterase inhibition in resistant than susceptible flies treated with the same dose of the organophosphate probably results from some other mechanism than detoxification. Flies treated with the organophosphate immediately after decapitation were similar to whole flies in the symptoms of poisoning and degree of resistance. Evidence is presented for a "factor" in the thorax and/or abdomen which contributes to resistance by reducing the rate of cholinesterase inhibition without destroying active anticholinesterase organophosphate.

- **Plapp and Casida 1958** - [865]


Acetone-water suspensions of solutions of radioactive DDT, Bayer 21/199, and Am. Cyanamid 12880 (p-C6H4CH3-p-(m,3-dimethyl-thiocarbamoylmethyl)-phosphorodithioate), labelled with C14 and P32 respectively, were tested against 4th-instar Anopheles quadrimaculatus Say and Aedes taeniorhynchus (Wied.) larvae (Culicidae; Diptera). Concentrations required for equivalent 24 h mortality were in the order of DDT < 21/199 < 12880. A. quadrimaculatus were more susceptible to DDT and 12880 but less to 21/199 than Aedes taeniorhynchus; however, at the LD50 only small differences (0.0003-0.0142 µg/larva) were seen between species and chemicals. Increasing the number of quadrimaculatus larvae per unit volume resulted in lower mortalities with DDT, but no change with 21/199 and 12880. A. quadrimaculatus larvae exposed to 21/199 for 48 h absorbed a maximum amount in the first few hours but the mortality increased with time. When quadrimaculatus larvae were transferred to clean water, 75% of the acquired dosage of 21/199 was excreted in 12 h. Live larvae of both species absorbed more 21/199 than did dead larvae. (From auth.)
* Winteringham 1959 - [156]

** H - 2 Mammals

Surveys

* Lidicker 1954 - [505]
* Winteringham and Barnes 1955 - [405]
* Winteringham 1957 - [724]

Bayer 22408

* Boyd and Arthur 1960 - [726]

Co-Ral

* Kaplanis et al. 1959 - [513]
* Krueger et al. 1959 - [514]
* Macequiet et al. 1966 - [515]
* Radeleff and Claborn 1960 - [516]
* Robbins et al. 1959 - [517], [538]
* Vickery and Arthur 1960 - [519]

** Delavan

* Arthur and Casida 1959 - [520]


P^21-labelled Delnav (2,3-dichloroanilin 5, 5-bis (O, O-diethyl phosphorothioate)) was applied to steers dermally and orally. Analyses of blood, urine, and feces indicated that the insecticide was rapidly metabolized and excreted. After 7 d both animals showed only trace amounts of radioactivity in the urine and feces, but the elimination of 50% of the dermal treatment indicates efficient absorption of the insecticide in comparison with other organophosphorus insecticides. The presence of three major hydrolysis products in the urine of both animals indicates a cleavage of Delnav at the P' 5 + C as well as the P' 5 - C bond, with oxidation before or after hydrolysis. (auth.)

* Flapp et al. 1960 - [521]

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* Jandorf, B.J., McNamara, P.D. INJECTION OF PHOSPHORUS-L 77-84.

When P^21-labelled diisopropylfluorophosphate (DIFP) is injected intramuscularly or intravenously in rabbit, P^21 is retained by the liver and various other organs and their ability to retain this is not altered when labelled diisopropylfluorophosphate (DIFP) is injected intravenously, plasma from a single labelled DIFP, monitored for 3 h. In the erythrocytes a marked decrease in the amount of P^21 is observed within 1 h after injection and this amount continues to be reduced with time, returning to zero at approximately 3 h. The results of these experiments indicate that DIFP is rapidly metabolized, probably by hydrolysis. (auth.)

* Kaplanis et al. 1959 - [553]

* Dauterman et al. 1959 - [553]
* Dauterman et al. 1960 - [553]
* Chilwell and Beecham 1960 - [553]
When P-32 labelled diisopropyl phosphorofluoridate (DFP), a highly toxic phosphorothioate ester, is injected intravenously in rabbits, P-32 is retained in relatively large amounts by kidney, liver, and lung; other organs take up only small amounts. No correlation seems to exist between the cholinesterase activity of organ and their ability to retain DFP-derived P. No significant retention of P-32 in any tissue was found when labelled diisopropyl phosphorofluoridate was administered. Of the total amount of DFP-derived P-32 retained in liver, lung, and kidney, about 100% of it is protein-bound within 4 h after injection. In plasma of rabbits injected with labelled DFP, most of the P-32 originally present is eliminated before regeneration of cholinesterase has started. In the erythrocytes a maximum value of P-32 associated with the cells is not attained until about an hour after injection and this level is maintained for at least 9 h. Maximum inhibition of cholinesterase is maintained for the same length of time, then both the radioactivity and inhibition decrease at the same rate and return to zero at approximately the same time. This indicates destruction of cholinesterase whose activity was destroyed by DFP, and their replacement with new cells containing active cholinesterase. (CA 44: 6578a, 1950)

Diazinon

* Kneger et al. 1960  -  [541]
* Robbins et al. 1957  -  [543]


Les auteurs ont préparé un diazinon marqué avec du phosphore radioactif. Après en avoir administré par os 25 mg à une chèvre en fin de lactation, ils ont mesuré la radioactivité des urines, des fèces, du sang et du lait. Cette étude montre une élimination rapide et complète du produit en 3 ou 4 jours. Seule l'élimination radioactive, d'autant plus extrêmement faible du lait reste linéaire et correspondait au 32P provenant des réserves osseuses après métabolisation de l'insecticide. Le dosage de l'insecticide lui-même, soit par extraction, soit par la mesure de l'activité anticholinérestasique des excrétions montre une élimination très faible (2-3 mg) de la dose totale en 4 jours, indiquant que la quasi-totalité de l'insecticide est métabolisé et le 32P éliminé sous forme de phosphates organiques ou minéraux auras que l'insecticide. Ce comportement différencie nettement les insecticides organophosphorés des insecticides chlorés.


A female goat (36.5 kg) was given a single oral dose of P-32 labelled Diazinon (C=O-diethylO-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate) towards the end of the lactation period. Excretion of radioactive material in the urine, faeces and milk, measured with a G-M counter was completed within 4 d, and the blood was free within 2 d. Only very small amounts were found in the milk or blood. Only the urine showed any ability to inhibit horse-serum cholinesterase, and this was of a low order and persisted only for 3 d. The trial was repeated with similar results a month later, and it is concluded that Diazinon, unlike the chlorinated-hydrocarbon insecticides, is rapidly metabolized in the animal body. (from US Pat. 4117234, 1959)

Dimethoate

* ChiWell and Beecham 1960  -  [638]
* Dauteeman et al. 1960  -  [502]
* Dauteeman et al. 1960  -  [503]
* Kaplanis et al. 1969  -  [553]
Ditoprex


A study was made of the metabolism and excretion of P-32-labelled Bayer L15/59 (dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate) by a lactating Hereford cow to which it was administered orally at the rate of 25 mg/kg and of its uptake by larvae of Hypodermis bovis (Digg.) in cows in the cow's back. Radioactivity appeared to be dissipated more slowly in the exudate in the cysts of H. bovis than in the blood. Only low levels of radioactivity were detected in larvae removed at various times after treatment, and the maximum per unit weight was found in those removed after 6-94 h. The percentage of radioactivity administered appearing up to 144 h after treatment in the milk is discussed. L15/59 was rapidly metabolized by the cow and eliminated in the urine. The rate of elimination is described. Ready absorption of L15/99 by the cow was implied by the small amount of radioactivity in the feces. Less than 5% of the dose was accounted for in fecal samples collected. (RAE-B 46; 21-22, 1969)

DNP

Sacks and Marott Sinex 1952 - [709]

Fumigans


The distribution of radioactive material in different tissues was examined, following absorption of C-14Cl. In order to study the metabolism of C-14Cl, monkeys were exposed to low vapor concentrations of the radioactive form. In monkeys inhaling air containing 46 ppm of C-14-labelled CCl4 for 130-380 minutes, about 50% of the inhaled CCl4 was absorbed. The highest concentration of deposited radioactive material was in the fat (7.94 times the concentration in the blood). C-14 was found in the blood carbohydrates, exhaled CO2 and urinary urea and carbonate. Most of the radioactivity in the urine appeared to be present in non-volatile fractions other than urea, carbonate, or amino acids. This material was retained on anion-exchange resins and was converted to another unidentified substance by hydrolysis. The equivalent of at least 53% of the absorbed CCl4 was eliminated in the expired air within 1800 h. The remainder was excreted to a large extent in the urine and feces. In monkeys receiving skin exposures to radioactive CCl4 vapor for 4 h negligible amounts of radioactive material were found in the blood and expired air. (cf. CA 46: 8136, 1951)

Strittmatter et al. 1960 - [423]

Malathion

Knaak and O'Brien 1960 - [564]

March et al. 1966 - [567]


Two Jersey heifer calves were each treated twice at an interval of two weeks with one US pint spray containing 0.5% P-32-labelled Malathion, and the fate of the Malathion and its metabolites was studied after the second application. The Malathion was rapidly absorbed, metabolized and eliminated in the urine; 80-99% of the radioactive material eliminated was in the form of water-soluble metabolites and degradation products, and the amount of activity appearing in the urine was greater in the first 24 h, after which it gradually decreased. The calves were killed one and two weeks after the second spraying, and residues in ten parts of the meat and in tongue, brain, spinal cord, thymus, thyroid, pancreas, kidneys, liver, heart, rumen, mesentery, bone, marrow and hide were determined radiochemically. Only water-soluble metabolites and degradation products were present in detectable quantities in the tissues, except in the hide, where some of the labelled compounds recovered after two weeks was in the form of unchanged Malathion and chloroform-soluble metabolites. Total residues in the meat cuts were low (0.05 - 0.15 ppm) and indicated very uniform distribution for the tongue were probably (0.2 - 2 ppm) found in the liver and spleen. The largest amounts (3.18 ppm) of radioactivity were found in the foreleg and hind leg and rumen (RAE-B 46; 177, 1967)

Sebile and O’Brien 1960 - [568]

Bennett et al. 1964 - [561]

Ganz et al. 1961 - [565]

Lamon and Harlow 1958 - [569]

Ahmed et al. 1958 - [571]

Jager 1953 - [576]

Jensen 1962 - [577]

Ludicka 1954 - [584]

Bowman and Casida 1958 - [581]


Dairy cows that ingested ethylphosphate daily in capsules for a period of 12 weeks were not detected in their milk residues in milk or tissues after 6 months. Calfes that were treated for 6 weeks with ethylphosphate activity. The compound was ineffective (from auth. summary)

Gatzell et al. 1957 - [596]

Loupludes 1958 - [600]

Flapp and Casida 1958 - [601]

Robbins et al. 1956 - [602]

Arthur and Casida 1958 - [604]

Gardiner and Kilby 1950 - [610]

Gardiner and Kilby 1962 - [612]
and indicated very uniform distribution throughout the animal. Somewhat higher values (0.15 - 0.18 ppm) for the tongue were probably attributed to the heifers’ habit of licking themselves. Higher residues (0.2 - 2 ppm) were found in thymus, thyroid, pancreas, liver and bone, and indicated that phosphorus from the degraded compounds was being used in the normal metabolic activities of the animal.

The largest amounts (3 - 18 ppm) were found in the hide. Chemical analysis for malathion in tissues of foreleg, hind leg and rump of the two heifers showed no detectable malathion (less than 0.2 ppm).

(RAE-B 45: 177, 1967)

* Seume and O'Brien 1960 - [589]

** Nicotine

* Bennett et al. 1954 - [831]

** Gans et al. 1951 - [895]

* Larson and Harlow 1956 - [896]

** Fenamiphos

* Ahmed et al. 1958 - [871]

* Jöger 1963 - [876]

* Jensen 1962 - [877]

* Lidicker 1964 - [884]

** Phorate

* Bowman and Casta 1958 - [890], [891]

** Phosdrin


Daily cows that ingested subacute doses of Phosdrin (dimethyl 2- methoxy carbonyl-1-methylvinylphosphate) daily in capsules for a period of 12 weeks showed marked blood-cholinesterase inhibition, but the insecticide was not detected in their milk or tissues. Tons with radioactive Phosdrin confirmed the lack of significant residues in milk or tissues and showed that the chemical was rapidly detoxified and excreted as dimethyl phosphoric acid. Calves that were fed on milk from the cows also showed reduced blood-cholinesterase activity. The compound was hydrolyzed by cow, calf and human plasma to yield dimethyl phosphoric acid.

(From auth. summary)

* Gattendam et al. 1957 - [906]

** Rommel

* Lowendes 1958 - [900]

* Plapp and Casta 1958 - [901]

* Robbins et al. 1956 - [902]

** Schradan

* Arthur and Casta 1958 - [904]

* Gardiner and Kilby 1959 - [910]

* Gardiner and Kilby 1959 - [912]
Hoffmann-Creder, D., Stedek, H. DISTRIBUTION AND FATE OF SCHIBADAN (R3-DIMETHYL-AMINO- 
PHOSPHONIC ACIDHYDRIE) IN MAMMALS, USING A RADIOACTIVE COMPOUND. Arch. int. Pharma-
codya. 89, 1 (1952) 74-81.
The distribution, destruction and excretion of the above named compound [2], an anticholinesterase, was 
investigated in rats and rabbits. It is less toxic than DFP. High concentrations of unchanged [1] were found in 
the liver and skeletal muscles, and in the latter most was found when the animal was convulsed. Little is 
found in brain in acute or subacute poisoning. Metabolic products were excreted in bile, urine and feces. 
The intraperitoneal route was the most effective mode of administration. (EM 21; 447, 1960)
*
Kilby 1963 - [622]
**
Fukuto et al. 1956 - [636]
*
March et al. 1955 - [640]
*
Tietz 1960 - [602]

Miscellaneous
*
Halberstadt 1958 - [502]
  * 1960/1960 - [503]
*
Plapp and Casida 1958 - [665]

II - H - 3 PLANTS

Surveys
*
Liptich 1954 - [505]
*
Metcalf 1960 - [613]
*
Physiol. 37 (1959) 1145-60.
Review article. The metabolites of insecticides produced by plants are known to be mostly derived from the 
organophosphorus insecticides with the exception of Aldrin which may be oxidized to Dieldrin. The residue 
of the relatively stable chlorinated hydrocarbons is largely reduced by the microflora in the soil. Activation, 
degradation, selective toxicity, etc., are discussed with frequent reference to results obtained by means of 
radioisotopes.
*
Balditt 1958 - [512]
*
Boyd and Arthur 1960 - [706]
**
Bradley and Whitaker 1958 - [644]
**
Clements
*
Pang and Theisen 1960 - [705]
*
Rabkin et al. 1954 - [702]
*
Lichtenstein and Schulz 1960 - [676]

* Winteringham 1961 - [761]
*
The aceticid and insecticide 2,3,6-triiodoanilidine 1,2,6-(H4) 
Loss of the Hercules AC-528 
formation of more polar derit 
were similar in persistence to 
insecticide initially applied 
esters and the diester derrit 
Hercules AC-528 were only 
plants. Several of the compone 
se agents when applied to j 
thiolate derivatives. Attempt 
the phosphorochloridate derivatives. Hercules AC-528 and certain 
application to plants are 
significance of the organoph 
the colorimetric method of a 
Hercules AC-528 was labelled 
Arthur 1958). (auth.)
*
Carrer and Gornor 1958 - [559]
*
Metcalf et al. 1959 - [559]
*
Reynolds et al. 1957 - [560]
*
Tietz et al. 1957 - [563]
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Tietz et al 1960 - [561]
*
Tomizawa and Sato 1960 - 
*
Toczko 1960 - [701]
*
Gee and Kiplani 1960 - [704]
*
Kiplani and Gigenavan 1955
*
Liptich 1932 - [888]
*
Liptich 1954 - [884]
*
Bowman and Casida 1937 - 
*
Bowman and Casida 1958 - 

178
CHIRADAN (BIS-DIMETHYL-AMINOETHYL)PHOSPHATE. Arch. Int. Phar macol., 1935.

* Winteringham 1951 - [761]

Delnav


The aceticid and insecticide, Hercules AC-528 (Delnav) is a mixture of the cis and trans isomers of 2,3-p-dioxanedithiol 5,6-bis (O-dicyethyl phosphorothioate) along with certain other phosphorothioates. Loss of the Hercules AC-528 components from plants resulted from volatilization, hydrolysis, and the formation of more polar derivatives and more potent anticholinesterase agents. The cis and trans isomers were similar in persistence so that the isomer ratio did not change during residue loss from that of the insecticide initially applied to the plants. No inter-conversion occurred on plants between the cis and trans isomers and the dioxane derivative, which is an impurity in the technical insecticide. The components of Hercules AC-528 were only slowly hydrolyzed on the plant surface but rapidly when absorbed into the plants. Several of the components were converted to more polar derivatives and more potent anticholinesterase agents when applied to plants. This conversion may be due in part to the formation of phosphorothioate derivatives. Attempts at chemical oxidation of certain components of Hercules AC-528 to yield the phosphorothioate derivatives were only partially successful. Several components of technical Hercules AC-528 and certain non-hydrolyzed derivatives formed from the Hercules AC-528 components after application to plants are not determined by the residue analysis procedure of Dunn. The toxicological significance of the organophosphate present in residues of Hercules AC-528 on crops but not determined by the colorimetric method of analysis cannot be fully evaluated with the limited data presented in the paper. Hercules AC-528 was labelled with 32P by preparation and purification techniques described earlier (Casida and Arthur 1958). (auth.)

D-System

* Carter and Gorman 1958 - [558]
* Metcalf et al. 1959 - [559]
* Reynolds et al. 1957 - [560]

Gusathion

* Tietz et al. 1957 - [562]
* Tietz et al. 1960 - [561]

Malathion

* Tomikawa and Sato 1960 - [570]

Nicotine

* Toczek 1960 - [701]

Parathion

* Gar and Kiplian 1956 - [574]
* Kiplian and Gegenava 1955 - [579]
* Lubilico 1962 - [583]
* Lubilico 1964 - [584]

Phorate

* Bowman and Casida 1957 - [589]
* Bowman and Casida 1958 - [589],[591]
plants growing in sand than in former plants than on the latter, since vapor by the leaves. This was
Scop. on the cut tops of broccoli contained radioactive material, to trace as readily into leaves of amounts were translucent for

* Hartley and Heath 1951 - [618]
* Heath et al. 1952 - [618]
* " 1963 - [617]
* Heath and Llewellyn 1953 - [620]
* Heath et al. 1953 - [620]
* Metcalfe and March 1953 - [625]
* Metcalfe et al. 1955 - [625]
* Stein 1952 - [627]


The translocation of FCl-labeled mums, broad and runner beans, in promoting translocation in with the products of photosynthesis dominantly upward toward the chrysanthemum following application in apple stocks. Although little occurred exclusively in the plant for Colens, beans and chrysanthemum into non-chlorotic Colens. In chrysanthemum as possibly, Colens the broadleaf sorghum certain species of aphids are polyphagous on plant tissue, 20-28 g/ (Aphis pomi Deg.)

(c.f. 1. "Experimental technique II. "Evaporation and absorption"

Wedding and Metcalfe 1952 - [627]

Ahmed et al. 1954 - [630]

Chatteen 1953 - [631]

David, W. A. L., Gardiner, B. A. APPLIED TO SEEDS. Ann. 4

The authors studied the process not selectively absorbed by broad-leaved plants. Maximum absorption occurred, accounting for the amount of radioactivity measured.


The absorption of the systemic insecticide bis(dimethylamino) fluorophosphate oxide containing F32 was studied and, where possible, comparisons were made with Schubas (bis(dimethylamino)phosphine oxide). The radio-oxide was absorbed by the roots of broad bean plants from culture solutions. The level of radioactivity in the plant increased as the solution was absorbed and was higher in the rest of the plant. The radioactivity of the remaining culture solution decreased as more of it was taken up by the plants, showing that the roots selectively absorb the oxide from solution. In this respect, it differs from Schubas, which is selectively rejected at similar rates of transpiration. At the end of a day with roots in the culture solution, the plants became free from aphids. The radio-oxide was absorbed more rapidly by


The radioactive anhydride was absorbed by the roots of broad bean plants placed in culture solutions containing it. The level of radioactivity in the plant increased as the solution was absorbed and was higher in the washed root than in the rest of the plant. The activity of the remaining culture solutions increased as more was absorbed, showing that the roots selectively reject the radioactive anhydride. The material was absorbed more slowly from soil than from sand. In both cases, the concentration per gram of tissue was highest in the leaves on the middle part of the stem. By introducing the insecticide by the cut tap-root technique, it was shown that 99% of the anhydride is decomposed within the plant in 8 days. The concentration of undecomposed anhydride in the plant necessary to give a complete kill of Aphis fabae Scop. was found to be about 50 mg/kg plant tissue. Dead aphids were found to contain about 15-20 mg/kg radioactive material calculated on the assumption that it was undecomposed anhydride. The honeydew of aphids feeding on treated plants was also radioactive. Absorption and translocation of the radioactive material occurred following application to the leaves of broad bean, cabbage, hop, pea and strawberry. In broad bean, radioactive material was detected within the leaf a few hours after it had been applied to the surface. In all plants, there was evidence that radioactive material is translocated to untreated parts. Much more was translocated to leaves younger than to leaves older than those treated. In favourable cases, where a large number of leaves on the plant was treated, where the plant held a large quantity of the anhydride applied, or where a heavy dose was given, either by repeated treatments or by use of high concentrations, insecticidal quantities of what was presumed to be the anhydride were translocated to untreated young growing parts of the plants. No measurable quantity of radioactive material was transpired by plants taking up the material through the roots.

Sulphur-35

* Arthur and Casida 1958 - [604]
* Batt et al. 1954 - [605]
* Bennett and Thomas 1952 - [606]

Schubas

* David 1950 - [609]

* Saethre and Chapman 1953 - [607]

Phosdrin

* Tunnell 1950 - [710]
* Tunnell and Cherevaak 1953 - [711]
plants growing in sand than in soil, and aphids were killed at lower dosages and in shorter periods on the former plants than on the latter. An appreciable part of the oxide absorbed by the room is given off as vapour by the leaves. This vapour was collected and shown to be radioactive and toxic to *Aphis fabae* Scop. on the cut tops of broad bean plants. Examples of *A. fabae* feeding on treated plants were shown to contain radioactive material. The radio-oxide was less soluble in lipids than Schradan and did not penetrate as readily into leaves of broad beans. Since it is also lost by vaporization from the plants, only small amounts were translocated following leaf applications to broad bean, cabbage and hops.

* Hartley and Heath 1951 - [616]
* Heath *et al.* 1952 - [618]
* " 1953 - [617]
* Heath and Llewellyn 1953 - [619]
* Heath *et al.* 1955 - [620]
* Metcalfe and March 1953 - [624]
* Metcalfe *et al.* 1955 - [625]
* Stein *et al.* 1952 - [627]


The translocation of 35S-labelled Schradan from dipped or sprayed leaves was studied in apples, chrysanthemums, broad and runner beans and *Coleus*. Light was found to be perhaps the most important single factor in promoting translocation in beans, apple, and chrysanthemums, suggesting that the insecticide moved along with the products of photosynthesis. The direction of translocation from lower to middle leaves was predominantly upward toward new growth although small amounts were found in the lowest leaves of apple and chrysanthemum following application to middle leaves. Upward translocation occurred largely in the phloem in apple stocks. Although limited upward translocation also occurred in the xylem, downwad translocation occurred exclusively in the phloem. No major difference has been observed in the ratio translocated/absorbed for *Coleus*, beans and chrysanthemums but in apples this proportion is greater. The breakdown of Schradan into non-chloroform-extractables varies between plant species and is far greater in beans than in *Coleus*. In chrysanthemums and apples the breakdown appears similar throughout the plant whilst in beans and, possibly, *Coleus* the breakdown in the untreated sections is higher. Concentrations necessary for the kill of certain species of aphids are given (90% mortality for *Aphis fabae* Scop. with 10-15 µg/g of fresh weight of plant tissue, 20-35µg/g for *Macrosiphum (Macrosiphoniella) tanborni* Gill. and 20-30 µg/g for *Aphis pomi* Deg.)

(cf. I. "Experimental techniques" by Bann *et al.*, and II. "Evaporation and absorption" by Bennett and Thomas)

* Wedding and Metcalfe 1952 - [629]

**Systox**

* Ahmed *et al.* 1954 - [630]
* Chatter 1953 - [631]


The authors studied the process of absorption of systemic insecticides by seeds. 35S-Systox thiol isomer was not selectively absorbed by broad bean seeds from 0.05% solution, but penetrated at an equal rate with the water. Maximum absorption occurred over a 24-h period but was quite variable with individual seeds. In comparing the amount of radioactivity in seed coat and cotyledons, it was found that after 4 h of soaking an
average of ca. 79% of the material was in and on the seed coat, but after 24 h only 35% remained. Removal of the seed coat from seeds treated for 4 h showed that insecticide held in the seed coat at time of planting was subsequently translocated into the growing plant in quantities lethal to Aphis fabae. Translocation occurred directly from the material absorbed in the cotyledons which passed to the leaves along with the food reserves. However, some of the toxicant was also found to have diffused out of the treated seed into the soil where it was subsequently absorbed by the roots. It is clear that these two methods of absorption also apply to seed coats where the relative rates of absorption depend upon the lipid and water solubility of the toxicant; the sorptive power of the coating substance, generally charcoal; and the adherence of the coating to the treated seed.

* David 1987 - [622]
* Fukuto et al. 1985 - [635]
* Fukuto et al. 1986 - [636]

754


Experiments are described on the metabolism of \(O,O\)-diethyl \(O\)-2-(ethylthio)ethyl phosphorothioate (Demeton-O) in cotton plants. Demeton-O prepared with \(^{13}C\) was applied to the bases of young plants, and leaves were picked after 10 d and treated by methods that are described to recover and isolate the metabolites. One of these was found by examination of its infra-red spectrum to be identical with \(O,O\)-diethyl \(O\)-2-(ethylisouropinyl)ethyl phosphorothioate (the thionophosphor sulphide), which is therefore shown to be a metabolite of Demeton-O. It is a secondary one, since the fifth step in the metabolism of Demeton-O in plants has been found to be conversion to the sulphone, \(O,O\)-diethyl \(O\)-2-(ethylisouropinyl)-ethyl phosphorothioate. (from RAE-A 46; 336, 1958)

* Hartley 1982 - [638]
* Metcalf et al. 1954 - [641]
* Metcalf et al. 1956 - [642]
* Metcalf et al. 1957 - [644]

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When the bases of young cotton and lemon plants were treated with dithio-Systox [\(O,O\)-diethyl \(O\)-2-(ethylthio)ethyl phosphorothioate] and Thimet [\(O,O\)-diethyl \(O\)-2-(ethylthiomethyl)phosphorothioate] synthesized from \(^{35}S\), the treated plants and isolated cotton leaves were used to determine the amounts of the \(O\)-2-(ethylisouropinyl) ethyl phosphorothioate, which was found to be much more soluble in water. The processes of metabolism for the two compounds were primarily oxidative. After uptake of dithio-Systox by cotton, lemon, bean or lucerne plants, the compound was oxidized very rapidly to produce the sulphone, \([O,O\)-diethyl \(O\)-2-(ethylthio)ethyl phosphorothioate], and more slowly to produce the corresponding sulphone, \([O,O\)-diethyl \(O\)-2-(ethylisouropinyl)ethyl phosphorothioate]. The sulphone and sulphone, were also oxidized to produce \(O,O\)-diethyl \(O\)-2-(ethylisouropinyl)ethyl phosphorothioate and \(O,O\)-diethyl \(O\)-2-(ethylisouropinyl)ethyl phosphorothioate, respectively. Thus, at intervals of a few days to a month after application, all 4 oxidation products may be present in plant residues, but no dithio-Systox remains. Thimet behaved in an analogous manner, but showed different rates of metabolism. The sequence of consecutive reactions for dithio-Systox and Thimet in isolated cotton leaves was plotted, and preliminary investigations on their kinetics were made. All the simple oxidative metabolites of dithio-Systox and Thimet were prepared in the pure state, and their properties recorded; the successive steps in oxidation increased the anti-cholinesterase activity of both compounds, as measured against fly-brain cholinesterase, the Thimet series being somewhat the more active of the two. Typical harvest residues of the dithio-Systox metabolites were evaluated in experiments in which the radioactive compound was used as a direct spray on cotton plants 2 d before harvest and as a seed treatment for lucerne. The results indicated that the ultimate toxic residues are present in only fractional parts per million. The application of the knowledge of the metabolism of these compounds to plants to analytical studies by cholinesterase assay is briefly discussed. (from auth, summary)

* Möhlmann and Tiers 1956 - [660]
* Stein and Smith 1954 - [660]
* Thomas and Gynn, Jones 1955 - [669]
* Thomas et al. 1955 - [649]
* Tiers 1954 - [651]

756


Partly review. Investigations a have been used. When Systox was shown to be distributed after absorption, Systox had to be determined to range from 1.5 to 2.5 ml/seed. (from auth, summary)

* Bowman and Casida 1958 - [660]
* Halbertsma 1959/1960 - [506]

757


Results of greenhouse trials of a formulation of Systox have been extended to the development of a formulation of Systox. Determination of O uptake and the rate at which the compound is accumulated by the foliage after a relatively short time after application. In the case of benzoate hexachloride, the ratio of benzoate hexachloride in the soil as well as the soil was determined to range from 1.5 to 2.5 ml/seed. (from auth, summary)

* Capron et al. 1959 - [670]

758


Before an insecticide can be considered as being safe it will not contaminate meat and milk. Before an insecticide is labelled Co-Ral and Delustron (A more detailed report was published in Agr. Res. Serv. US Dept. of Agriculture, 1954)

* Kaplans et al. 1959 - [632]
After 24 h only 35% remained. Removal in the seed coast at time of planting site to Aphid fabae. Translocation passed to the leaves along with the internalized seed into the cotyledons. Thus two methods of absorption were possible: lipoid and water solubility. Upon the lipoid and water solubility of charcoal particles the adherence of the sulphur to the bases of young plants, and its recovery and isolation from the metabolite to be identical with Q, Q-diethyl phosphorothioate, is therefore shown to be in the metabolism of Dimethoate in Q-2-(diethylphosphino)ethyl phosphorothioate.

**Mihlmaun and Tiets 1966 - [645]**

**Stein and Smith 1956 - [646], [647]**

**Thomas and Glynn Jones 1955 - [648]**

**Thomas et al. 1955 - [649]**

**Tierts 1964 - [651]**


Partly reviewed. Investigations are reported in which radioactive tracer-labelled Syrosen (S35) and Ompa (P32) have been used. When Syrosen is applied to the stem or leaves of citrus plants it is translocated both up and down in the phloem at first, but gradually diffuse into the xylem. The rate of movement in the phloem was determined to range from 2.5 to 10 cm/h.

**Miscellaneous**

**Bowman and Casta 1956 - [655]**

**Halberstadt 1959/1960 - [503]**


Results of greenhouse trials indicated that some of the eradicating agents inhibited the absorption of P and arrested the development of seedlings. This was especially true of Al3(0H)6 and benzene hexachloride.

Determinations of O uptake and P content of excised root tips showed that reduction in P accumulation in the tissue was accompanied by a decrease in the rate of O consumption. This response occurred within a relatively short period after the tissue had been exposed to the biocides, and was especially marked in the case of benzene hexachloride. The results point out the importance of obtaining uniform distribution of biocides in the soil as well as using the proper application rate to avoid injury to livestock planting stock. (from CA 49: 9754d, 1955)

**II - I Insecticide Residues in II - I - 1 MAMMALS**

**Bibliography**


Before an insecticide can be recommended for use on livestock, studies must be made to determine whether it will contaminate meat and dairy products. Results of residue studies show that all the chlorinated hydrocarbon insecticides, Co-Ral, and Malathion were excised in the milk after spray treatments. Studies were also made on DDT, DDE, methoxychlor, Chlordane, gamma Chlordane, Hepachlor, Dieldrin, Lindane, Strontium, Toxaphene, Malathion, and Co-Ral in the fat of beef cattle following spray treatments. P32-labelled Co-Ral and Dieldrin were employed.

(A more detailed report was published in Dec. 1960 by Claborn and Radeleff "Pesticide residues in meat and milk" Agr. Res. Serv. US Dept. Agric., ARS-53-65, which also includes results on residues from insecticides on pasture and forage crops)

**Kaplanis et al. 1959 - [513]**

183
and fed to animals. Br\textsuperscript{131}0 of this method and was used for the radioactive DDT was milled under typical extraction) and 11.2 ppm insecticide was in a combined form fiv-extraction). The insecticide was for-
excreta behaved as the di-(4-1\textsuperscript{3}H) urine of a man following inges-}
\textsuperscript{3}H-labelled material.

761 Winterton, F.P.W., RAD
Chem., Ind., discussion)

Use of a radioactive bromine 1 \textsuperscript{131}0 in wheat grain to be followed. The Br\textsuperscript{131}0-labelled decomposition of residual DDT having been ont-found. Fumigation of wheat by C\textsuperscript{131}0. The fate of the methyl group drew attention to somewhat slower insecticides, using \textsuperscript{131}0.

762 Dupée, L.F., Heath, D.F., P.<br>
DIAMIDIC FLUORIDE (DIMEPl)

A satisfactory method for the determination \textsuperscript{131}0 ppm or less. The most geo-fluoridation, extracting with chloro- in the distillate is estimated and distillation apparatus, and distillate can sometimes be used. The results are obtained by adding known quant-
ements.

763 Chilwell, E.D., Beecham, P.<br>
PHOSPHOROTRIOTHIONATE (DIMEPl)

A method for the determination of phosphorothioate (DimePl) chemical and biochemical interference from metabolites. It is about 5 \mu g of DimePl, \textsuperscript{131}0 obtained in 15 crops, and some by adding known quan-
s.

764 Winterton, F.P.W., HYDROCARBON RESIDUES IN FOOD PRO-<br>

The chemical fate of methyl ethyl whole-wheat flour was exposed fraction was prepared from volatiles products obtained on

II - 1 - 2 PLANTS

Survey

* Metcalf et al. 1954 - [507]
* Redemann and Melkie 1958 - [791]


This is a bibliography of the literature published principally in 1955-57, arranged in sections concerned mainly with the level of residues on foodstuffs of plant origin, the effects of residues on domestic animals and plants, residues in soils, and methods of residue determination, including bioassay. Includes references relevant to the present bibliography. Alphabetical listing by first author. No index.

BHC

* Bridges 1958 - [447]

DDT


A radioactive bromine analogue, 1:1:1-trichloro-2:2-di-(4-bromo-\textsuperscript{3}H)ethane, of the insecticide DDT has been used to indicate the fate of DDT sprayed on to wheat grain which is subsequently milled, baked
and fed to animals. \(^{3}^{13}C\) of high specific activity was prepared in the Harwell pile by the Seaborg-Chalmers method and was used for the synthesis of the analogue. Grain carrying 40.2 ppm of the labelled insecticide was milled under typical conditions. A concentration of 14.6 ppm was found in the flour (85% extraction) and 11.2 ppm in bread made from the flour. There was evidence that some of the insecticide was in a combined form in the bread. Some of the grain and bread were fed to hens and rats respectively. The insecticide was found in all the tissues examined. A fraction of the radioactivity found in the excreta behaved as the di-(\(\alpha\)-bromo\(\beta\)phenyl) acetic acid metabolite. This metabolite was identified in the urine of a man following ingestion of some of the bread. (auth.)

\(^{3}^{13}C\) \(\beta\)-labelled material.


Use of a radioactive bromine analogue of DDT allowed the fate of the insecticide on contamination of the wheat grain to be followed. The suspected decomposition of residues in bread during baking was confirmed. \(^{14}C\)-labelled decomposition products were located and estimated radiochemically, the greater part of the residual DDT having been oxidised to the benzophenone derivative; some ethylene derivative was also found. Fumigation of wheat by methyl bromide was studied by means of labelling methyl bromide with C\(^{14}\). The fate of the methyl groups introduced in milled wheat is described. In the discussion, D. P. Heath drew attention to somewhat similar work being done by his group on the fate of systemic phosphorous insecticides, using P\(^{32}\).

Dimefox


A satisfactory method for the determination of Dimefox residues in food crops must achieve a sensitivity of 0.1 ppm or less. The most general method consists of macerating a 50 g sample of the crop with water, filtering, extracting with chloroform, evaporating the chloroform to a low bulk, transferring to a micro-distillation apparatus, and distilling in the presence of a few drops of glycerolglycol mixture. The Dimefox in the distillate is estimated as phosphate by the method of Bernsheim and Click. An abbreviated version can sometimes be used. The second method, used for oily crops, consists of distilling a macerate in oil and separating the Dimefox from interfering compounds in the oily distillate. Satisfactorily low blanks were obtained on 15 crops, and satisfactory recoveries on 10 crops investigated further. Recovery data were obtained by adding known quantities of \(^{14}C\)-labelled Dimefox at an early stage in the analysis procedure. (from auth.)

Dimethoate


A method for the determination of residues of the insecticide O\(_{2}\)-dimethyl S-(N-methylcarbazolymethyl) phosphorothiolethionate (Dimethoate) in crops is described. \(^{14}C\) was used for labelling the insecticide. Radiochemical and biochemical investigations indicate that the method can be applied to growing crops without interference from metabolites in the plant derived from Dimethoate. The limit of sensitivity of the method is about 5 \(\mu\)g of Dimethoate, equivalent to 0.1 ppm in the plant tissue by the method described. Harvest residues found in many British and overseas crops 1-3 weeks after spraying with Dimethoate are given. (from auth.)

Fumigants


The chemical fate of methyl bromide absorbed by wheat under conditions of fumigation has been studied. Whole-wheat flour was exposed to C\(^{14}\)-labelled methyl bromide. The fat, starch, gluten, and water-soluble fractions were prepared from the exposed flour and their C\(^{14}\)-content assayed. The gluten or protein fraction was responsible for some 80% of the decomposition of the absorbed fumigant. By measuring the C\(^{14}\) of the volatile products obtained on treating the gluten with sodium hydroxide or hydrochloric acid under different
conditions, it was shown that the decomposition of methyl bromide in gluten was due almost entirely to methylation with the formation of 50% of N-methyl derivatives, 30% of dimethyl sulphonium derivatives, and of 20% of methoxyl and dimethoxyl derivatives in about equal proportions. Similar results were obtained when gluten alone was exposed to the labelled fumigant. The production of free methanol in the flour by hydrolysis of the absorbed fumigant was about 10% or less. The rate of spontaneous decomposition of the dimethyl sulphonium compounds formed as a result of fumigation was estimated by using wheat which had been grown on Sn-labelled sulphate. (auth.)


The principal reaction between C^14-labelled methyl bromide and the nitrogen-containing groups of wheat protein has been shown, by combined radioactive tracer-chromatographic techniques, to be with the histidine residue. Three methylated histidines are present in the hydriodic acid hydrolysate of the protein that has been exposed to methyl bromide, and these have been identified as 1-N-methylhistidine, 3-N-methylhistidine and 1,2,3-trimethylhistidine. The amount of reaction occurring under typical fumigation conditions is so small that the loss of the semi-essential amino acid, histidine, is negligible. (auth.)


Ethylene dibromide labelled with radioactive bromine (Be^{3}Be) was used to study the absorption in wheat during fumigation and on subsequent sun-drying and heating. In spite of the high physical sorption of the fumigant and its slow rate of disappearance, there is little chemical reaction between it and the wheat at room temperature. When fumigated wheat that has been imperfectly dried is heated, part of the ethylene dibromide seeps out and undergoes decomposition to ethylene glycol and brominated glycol, the remainder being lost by volatilization, as ethylene glycol is a less toxic material. Heating provides a safeguard against possible poisoning due to ethylene-dibromide residues. There is some evidence that the glycol formed reacts with the wheat protein. The hydrogen bromide liberated when the ethylene dibromide is decomposed by heating appears to cause some splitting of the rachis-grain sheaths. It is concluded that no significant changes appear likely to take place in the nutritive value of wheat as a result of fumigation.


The major products of the chemical reactions between methyl bromide and the components of wheat under the conditions of fumigation have been characterized or identified. Their rate of absorption by an adult human consuming fumigated flour products has been estimated. The likely nature of the effective end-products of human digestion has been considered and is believed to be represented by the compounds methanol, methylglyoxal, S-methylcysteine, methyl methionine sulphoxide salt, and N-methyl derivatives of histidine and lysine. These appear to be compounds which have been fed experimentally to mammals at concentrations very much larger than those likely to be obtained in fumigated wheat. In some cases their metabolism in vivo has also been studied. On the basis of all the available data an appraisal has been made of the toxicological and nutritional significance of consuming fumigated flour products. There is no evidence that the principal fumigant decomposition products are toxic or that their formation would be associated with any significant reduction in essential food constituents. C^14-labelled methyl bromide was used (see Winteringham, Harrison, Bridges and Bridges, 1955) (from auth.)

Guassion

* Tiers et al. 1957 - [582]
* Tiers et al. 1960 - [581]

Malathion


* Jackson and Hopkins 1952 - [596]
* Casida et al. 1956 - [600]
* Halbertstadt 1959/1960 - [590]
Gluten was due almost entirely to dimethyl sulphoxide derivatives, sorbitol. Similar results were obtained with extraction of free methanol from the rate of spontaneous decomposition of gluten was estimated by using wheat which

**FOOD PRODUCTS. III. N-METHYLMELIDE. J. Sci. Food Agric.**

* * 

* Glucose-containing groups of wheat its techniques, to be with the acid hydrolysate of the proteins, an 1-N-methylhistidine, 3-N- occurring under typical fumigation conditions, is negligible. (auth.)

**FOOD PRODUCTS. V. THE NATURE OF WHEAT. J. Sci. Food Agric.**

* * 

* Study the absorption in wheat during physical movement of the fumigant and even in and the wheat at room temperature, part of the ethylene dibromide in the remaining being lost by the use of a safeguard against possible gas forming cracks with bromide is decomposed by heatingceeded that no significant changes fumigation.

**USES IN FOOD PRODUCTS. IV. THE FUMIGATING WHEAT WITH METHYL**

* * 

* and the constituents of wheat under its rate of absorption by an adult life nature of the effective end-processed by the compounds. Potassium salts, and N-methyl derivatives have been used experimentally to mammals treated wheat. In some cases their value data an appraisal has been made to flour products. There is no evidence of formation would be associated with methy bromide was used (see

**PHASOLEUS VULGARS. J. econ.**

* * 

* By using 3H-labelled Malathion, the speed of migration of Malathion in the tissues of *P. vulgaris* L. was measured. Speed of migration was found to be very low in leaves. Malathion was taken up by the leaf tissues very rapidly, and the rate of entry of Malathion into the tissue was found to satisfy Langmuir's absorption equation. It was found also that the slow dissipation of Malathion residues in the later stage (resistance stage) in this experiment was owing to the lower rate of evaporation effect by absorption of the insecticide by plant tissue. (auth.)

Parathion

* Gar and Kipling 1956 - [974]

* Turrell 1956 - [710]

* Turrell and Chervenak 1959 - [711]

Scherdan

* Glyne Jones and Thomas 1953 - [813],[814]

* Heath et al. 1952 - [818]

* Heath et al. 1953 - [817]

* Heath and Llewellyn 1953 - [819]

* Heath et al. 1956 - [821]

* March et al. 1954 - [823]

* Metcalfe et al. 1955 - [825]

Systox

* David and Gardiner 1955 - [753]

* Hartley 1952 - [838]

* Metcalfe et al. 1955 - [843]

* Mühlmann and Tietz 1956 - [845]

* Stein and Smith 1954 - [846],[847]

* Thomas and Glyne Jones 1955 - [648]

* Thomas et al. 1955 - [849]

* Tietz 1956 - [850]

Miscellaneous

* Cast et al. 1956 - [660]

* Halberstadt 1929/1960 - [503]

II-1-3 SOIL

* Jackson and Hopkins 1952 - [472]

Very useful book, with extensive lists of references, including isotope dilution techniques, nuclear reactor facilities and handling of radioactive materials, and procedures for individual nuclide analysis. An author and subject index is included.

Duncombe, W. G. *An Autograph of P32 and Sulphur-35*. The method used by Gilly (1966) for labelling film coated with photographic emulsion with Kodak "Kodirex" film was used to distinguish easily. It might be useful for other purposes.


Specimens labelled with both P32 and S35, and preparing autoradiographs on one film, while the high-resolution technique is described.


An optical system for scanning of the sections in a strip of the autoradiographs is used, followed by the presentation of the distribution of the counts and data for an autoradiographic preparation on a microtome section. The results are evaluated in a quantitative manner.

Metcalfe 1960 - (413)

Stern, J. L. * Autoradiography of Nucleic Acids*. Work on nucleic acid of somatic cells in P32-labelled methionine was used to study the relations between DNA, RNA, and proteins.

Winteringham, F. P. W., Harries, S. *Autoradiography in Histological Techniques*. One method used for locating radioactive material was employed for dehydration and stripping of the material, followed by a combination of techniques. The method is described.
III TECHNIQUES

Survey

Comar, C.L. RADIONISOTOPE IN BIOLOGY AND AGRICULTURE, PRINCIPLES AND PRACTICE.
Very useful book, with extensive bibliography. The principles of tracer methodology are discussed in detail, including isotope dilution techniques and double labelling. Different chapters deal with basic difficulties; facilities and handling of radioisotopes in animals and plants; general procedures for radioassays; properties and procedures for individual radioisotopes; autoradiography; paper chromatography; and radioactivation analysis. An author and subject index are included.

III - A Autoradiography

The method used by Gillies (1953) for studying insects labelled with both $^{32}P$ and $^{35}S$ was modified by using film coated with photographic emulsion on both sides such as in most commercial x-ray films. Kodak "Kodirex" film was used for radiography of chromatograms which enables the two isotopes to be distinguished easily. It might be feasible to distinguish more than 2 isotopes by this method.

Specimens labelled with both $^{32}P$ or $^{35}S$ could be distinguished by covering them with two pieces of x-ray film, and preparing autoradiographs. The low-energy $^{32}P$ particles (0.187 MeV) were found to blacken only one film, while the high-energy $^{35}S$ $\beta$-particles (1.71 MeV) penetrated the first film and blackened the second as well. $^{32}P$, in addition to $^{35}S$, is being used for field studies on Anopheles gambiae. The technique is described.

An optical system for scanning autoradiographs is described. It is based essentially on forming a band pattern of the grains in a strip of the autoradiograph by means of a cylindrical lens camera and on the photoelectric recording of the distribution of band intensities along the strip. Examples in which Prosopis salviary gland preparations are used for measurements are given, where the DNA was measured in terms of $^{32}P$.

* Metcalfe 1960 - (413)

Work on nucleoli of somatic cells, including those of the salivary gland of Prosopis, is described where $^{35}S$-labelled methionine was used. This and other results are discussed, emphasis being placed on the relations between DNA, RNA, and associated and non-associated proteins.

One method tried for locating water-soluble $^{32}P$ in larvae of Calliphora erythrocephala (alcoholic AgNO$_3$ was used for dehydration and precipitation of the halide in situ) caused some damage to the tissue and the stripping emulsion applied afterwards. Useful autoradiographs of $^{32}P$ have been obtained of larvae poisoned by methyl loddie, by a combination of the Allmann-Gersh process and a modified stripping-emulsion technique. The method is described in some detail with some illustrations.
III - B Dosimetry


Mechanical details of an apparatus for exposing grasshopper embryos to radiation from a 365-nm blacklight are illustrated. An accurate determination is possible of the amount of radiation to which the cells have been exposed. Maximum protection is provided for the operator. (ASA 6: 3897, 1952)


A method is given for calculating the dose of radiation, in rad, absorbed by adult Tribolium castaneum (L.) when irradiated with high-energy electrons from a Van de Graaff accelerator. The expression for dose is based on (1) the power output of the accelerator; (2) the amount of time the target (insect) is in the beam; (3) the fraction of the scanned area occupied by the target; (4) the fraction of the energy of the incident electrons which is lost in the target; and (5) the mass of the target. The expression is developed in detail on the basis of the ideal case, but possible departures from the ideal in practice are discussed. The physical parameters of the insect which pertain to the calculation of dose are reported. (auth.)

* King 1952 - [386]

777 Klopf, W. DIREKTES UND INDIREKTES VERFAHREN ZUR MESSUNG DER BETA-SCHWACHABSORPTION VON KLEINEN GEWEBEBLICKEN AUF INSEKTEN. (Direct and indirect techniques for measuring beta-ray absorption) 2-1/2 Gläser: Instrumenten-Technik 5, 3 (1953) 79-110. (In German)

In order to determine directly the absorption coefficients for beta-rays of different tissues, the various tissues layers of the 365-nm labelled insects are removed. Changes in radiation intensity thus produced are measured. For a known, microscopically determined tissue thickness the true activity (minus the absorbing tissue) may be calculated from the measured impulse rate. In the indirect method, the original impulse rate is re-established by interpreting aluminum foils of known surface density, which will give data on the collimated cuticle. Possible errors and experimental details are discussed, and also other applications of the technique.

III - C Isotope Dilution


Considerable disagreement among a number of analytical methods for determination of the lambda-isomer of benzene hexachloride led to the development of a new isotope dilution method using C-14-labelled pure gamma-isomer as a tracer. A known quantity of chemically pure radioactive gamma-isomer of benzene hexachloride, labelled with C-14, is added to a known weight of a technical benzene hexachloride sample of unknown gamma-content. A sample of pure gamma-isomer is then isolated from the mixture by an extraction procedure. The specific activity of the isolated material is compared to that of the original labelled isomer. The standard deviation of the method is 0.2% in gamma-isomer content. Four determinations can be made by one analyst in an 8 h day. This analytical procedure can be classified as an absolute method and is being used as a referee for other routine methods for the determination of the gamma-isomer. It is being used to analyse benzene hexachloride samples having gamma-content ranging from 1% to 50. (auth.)

779 Craig, J.T. MEASURING THE ACTIVE INGREDIENT IN AN INSECTICIDE. CASE STUDY. Nucleonics 14, 3 (1956) 60-1.

The essentials of the isotope dilution method are outlined. C-14-labelled pure gamma-isomer was used as tracer, primarily because of the ease of affixing the labelled atoms to the molecule of BHC. Technical details are given. (See also Craig 1960, where methods and results are discussed in some detail)

Labeling of benzene hexachloride by means of the C¹⁴-labelled pure γ-isomer is described, including precautions taken to ensure purity and safety. Some details of assay procedure (see Craig et al., 1953) are given, and the accuracy and uniformity of the results discussed. Tabulated results indicate the precision of the isotope dilution method, also compared with the infra-red method and with paper chromatography. Collaboration studies between different laboratories on the percentage of γ-isomer in various samples of technical grade BHC indicate close agreement as well as fine precision within each lab.

III - DLabelled Pool Technique

Winteringham and Hellyer 1954 - [729]


For the study of adult houseflies under the influence of an insecticide, 1 ml H₂O containing 18 γ Na acetate-D-²-C⁴, equivalent to 2 µ C⁴, was injected intrathoracically. Immediately afterwards, 1 ml Me₂CO (control) or 1 ml Me₂CO containing 10 γ diisopropyl phosphofluoridate (I) was applied topically. By paper chromatographic separation (Winteringham et al., CA 49: 561b) of extracts of heads and thoraces, 2 distinct C⁴-labelled fractions were resolved. The mean % values (H₂O-fomica acid-acetone) were: (I) 0, (II) 0.25, (III) 0.47, (IV) 0.58, (V) 0.66, (VI) 0.75, and (VII) 0.91. Fractions 3, 5 and 6, representing 75% of the total soluble C⁴, were identified as glutamine, glutamic acid, and proline. Hydrolysis of the insoluble thoracic protein showed that almost all the protein C⁴ was present as glutamate and proline only. No detectable fraction of the soluble C⁴ behaved as free choline. The proportion of C⁴ found in the acetycholine (II) fraction was independent of the weight of unlabeled II added at any stage of the fractionation, which fact showed that no isotope exchange occurred between carrier and some other labelled metabolite. II was labelled in vivo in the acetyl moiety only. The glutaminic acid accumulation suggested that II may have rendered necessary an H₂O detoxification mechanism. There was a relative rise of II after 1 h, followed by a fall to normal after 2 and 5 h; this suggests that the cholinesterase inhibition was reversible. (CA 51: 1944c, 1957)


By feeding suitably labelled substrates to insects, well-defined metabolic pools become rapidly labelled which may then be separated and resolved by suitable chromatographic techniques. Multi-dimensional paper chromatography may be used; separated compounds may be scanned on unit-dimensional strips for quantitative evaluation of the particular labelled compound. The soluble phosphorus pool of adult houseflies domesticus L. was studied by feeding carrier-free P⁴³. The nature and relative specific activities of the P³¹-labelled intermediates extracted from tissues were determined by co-chromatographic and neutron activation techniques. This technique has also been extended to the use of C¹⁴-labelled pools.

Winteringham 1958 - [418]

Winteringham et al. 1958 - [790]

Winteringham 1959 - [158]

Winteringham et al. 1960 - [495]
III - E  Paper Chromatography

* Metcalfe 1960  [413]

784 Winteringham, F. P. W., Harrison, A., Bridges, R. G. ANALYSIS OF DDT DERIVATIVES BY REVERSED-

In order to study the metabolism in insects of a radioactive bromine analogue of DDT, (BrC₂H₅)₂CHCCl₄ (I), a method was developed for the separation and estimation of (I) and the possible metabolites, (BrC₂H₅)₂CHCCl₂ (II) and (BrC₂H₅)₂CHCOOH (III) on the micro-plate scale. Mixtures of such compounds labelled with Br² were analyzed by reversed phase uni-dimensional paper partition chromatography. Details of the resolution obtained and the time factors involved are given. No isotope exchange between compounds was detected when a mixture containing radioactive (I) and inactive (II) and (III) were resolved.

785 Winteringham, F. P. W. RADIOCHEMICAL TECHNIQUES IN ANALYSIS. Nature 165 (1951) 153-5.

Summary of a meeting of the Society of Public Analysts and Other Analytical Chemists. For relevant paper presented, see 786 and 787.

786 Winteringham, F. P. W., Harrison, A., Bridges, R. G. RADIOACTIVE TRACER-PAPER CHROMATOGRAPHY
TECHNIQUES. Analyst 77 (1952) 19-26.

An example of the application of this technique is cited where mixtures of DB³²DDT and its metabolites, "DB¹⁸⁸DE" and "DB²⁸³DA", were resolved. The uses and possibilities of combined radiochemical and paper chromatography techniques are discussed. The principle of the method is to associate one or more radioactive isotopes with one or more substances separated on a paper chromatogram. The labelled substances can then be located and estimated by scanning the paper radiometrically. A simple device for doing this automatically, and its use in quantitative work is described. (From auth.)

787 Winteringham, F. P. W., Harrison, A., Bridges, R. G. RADIOACTIVE-TRACER TECHNIQUES IN PAPER
CHROMATOGRAPHY, Nucleonics 12, 3 (1953) 92-7.

Their application to paper chromatography may permit the separated components not only to be located and characterized but to be estimated quantitatively. The principle is to associate one or more radioactive isotopes with one or more of the components of the mixture, either before or after chromatography. The components separated on the chromatogram are then located and estimated by their associated radioactivity. Each method of associating the isotopes with one or more bands of the resolved components of the chromatogram is described, as follows: labelling of mixture before paper chromatography, treatment of chromatogram with labelled reagent, and neutron activation of the chromatogram. Diagrams are presented of a device which automatically scans the chromatogram. Methods of quantitative interpretation of the results and necessary corrections are discussed. This method has been used to resolve mixtures of DB³²DDT and its metabolites, "DB¹⁸⁸DE" and "DB²⁸³DA".

* Winteringham, et al. 1958  [786]

III - F  Miscellaneous

788 Green, R. C., Spinde, J. W. T. AUTOMATIC PLOTTING OF THE POSITION OF A MOVING RADIOACTIVELY

An apparatus is described for automatically registering the movement of an object in the three dimensions of space and in time. It has been designed specially in order to register the movements of a Myriapod burrowing into the ground. The fundamental principles in which the apparatus is based are discussed. The description includes a thyroid, a Geiger counter, and a counter for 20 μc of Cs¹³⁷.

789 Green, R. C., Spinde, J. W. T., LATE-EIGHT MORNING PICTURE STUDIES OF SOIL-BURROWING INSECTS.

A machine had been developed for the automatic recording of radioactively tagged insects such as a wireworm. By means of the tag and the machine the wireworm was effectively provided with a pencil. The movements of the pencil and the machine were photographed, using latest-time technique. A tagged wireworm was liberated in a tray, and a sheet of glass over the Geiger axis, and held in contact, was thus traced on the lower side for viewing through the glass sheet...
wireworm was liberated in a tray of soil placed on the floor. The machine was placed on a table above the tray, and a sheet of glass over the machine. A piece of grease pencil was attached to the machine on the Geiger axis, and held in contact with the under-surface of the glass by a spring. The path taken by the worm was thus traced on the lower side of the glass sheet. A 16 mm cine camera was mounted above the machine for viewing through the glass sheet. The particular wireworm travelled at the rather high speed of 25 in/hr.


A simple modification of a microloop is described which enables a drop of 0.1-0.8 ml of insecticide or another substance in a suitable solvent to be placed with precision on a selected area of a small organism (e.g., as required for topical applications to insects). The construction is described, and also methods for calibration. The three methods were (1) spectrophotometric; (2) colorimetric; and (3) radioactivity, using 1.9% 14C-DDE-C14 (one loopful applied to a filter paper disc of 2.97 cm2), activity being measured in a Geiger counter.

791 Offedal, P. HANDLING RADIOACTIVE FLIES. Drophiila Inform. Serv. 30 (1956) 103-4.

An apparatus made of Perspex is described for handling flies (both insertion and removal from a capsule) which eliminates the need for repeated etherisations. It is illustrated by two figures.

792 Offedal, P. MEASURING THE VOLUME OF INJECTION NEEDLES. Drophiila Inform. Serv. 30 (1956) 165.

A simple tracer method is proposed. A very weak solution of a fairly high-energy β-emitter (e.g., P32) is expelled into a drop of water on one of the usual plaquettes used in most scalar assemblies. The solution is then diluted 1:100 or 1:1000, and a known volume, e.g, 5 ml of it pipetted onto a similar plaque. After evaporation to dryness, the plaquettes are placed under the G-M tube for radioactivity. A comparison of the 2 activities, corrected for the relevant dilution factor, gives the volume with a high degree of precision. To minimize inaccuracies due to adsorption to the pipette walls, the solution used should contain inactive carrier isotope.


By irradiation with the Harwell pile followed by distillation from HCl and free Cl solution, precipitation by (NH4)2HPO4 and counting it, it was possible to detect 0.001 g of As within 1% of the truth. With Ge present, the counting is done through an absorber or better by scintillation spectrometer to diminish the contribution of the low-energy As activity desired from Ge. (CA 46: 11091h, 1952)


TRACER/PAPER CHROMATOGRAPHY

Tracer paper chromatography and its metabolites, of combined radiochemical and paper chromatography. The labelled substances by a simple device for doing this (2th.)

-TRACER TECHNIQUES IN PAPER

components not only to be located and associate one or more suitable radioactivity and after chromatography. The activity of their associated radioactivity. resolved components of the paper chromatography, treatment of a" chromatogram, Diagrams are presented quantitative interpretation of the used to resolve mixtures of DDT

4

POSITION OF A MOVING RADIOACTIVELY

5 307-16.

An object in the three dimensions the movement of a myriapod

4

of SOIL-BURROWING INSECTS,

be tagged insects such as a wire-

aced with a pencil. The

one-time technique. A tagged
IV BIBLIOGRAPHIES AND GENERAL SURVEYS

IV - A Bibliographies


This bibliography covers the period 1959-1966, "to be continued in subsequent issues."


Amongst the 807 selected references on techniques for the use of radioactive and stable isotopes in the biological sciences, taken from the 1948-1956 open literature, there are some which are relevant to this bibliography. The percentage is not very high. An author index and an alphabetical listing of literature reference sources are included.


This bibliography contains 2450 selected references on uses of radioisotopes in biochemistry and biosynthesis of labelled compounds, taken from the 1948-1956 open literature. Some references come within the range of the present bibliography. A list of the journals from which the references were selected and an author index are included.


Nearly 6000 references cover work with radioactive and stable isotopes. Reference is only made to material appearing in scientific technical and professional journals during the 3 years ending Dec. 1957, or, more specifically, since publication of Isotopes: An Eight-Year Summary of United States Distribution and Utilization, dated March 1956. An author index and a key to journal abbreviations are included. Sections of interest are underlined.


The 2450 references cited in this bibliography, and obtained from 1948-1957 open literature, include those that have appeared in ISOTOPES: A Three-Year Summary of U.S. Distribution (1949); ISOTOPES: A Five-Year Summary of U.S. Distribution (1951); ISOTOPES: An Eight-Year Summary of U.S. Distribution and Utilization (1955); ISOTOPES: A Bibliography of United States Research and Application 1955-1957 (1958). A list of journals from which these references were selected and an author index are provided.


This bibliography contains 1500 references. These references were selected from those that have appeared in ISOTOPES: Five-Year Summary of U.S. Research and Utilization (1955) and ISOTOPES: A Bibliography of United States Research and Application 1955-1957 (1958). A list of the journals and authors is included.


This bibliography contains 1500 references. These references were selected from those that have appeared in ISOTOPES: Five-Year Summary of U.S. Research and Utilization (1955) and ISOTOPES: A Bibliography of United States Research and Application 1955-1957 (1958). A list of the journals and authors is included.


This bibliography contains 1500 references. These references were selected from those that have appeared in ISOTOPES: Five-Year Summary of U.S. Research and Utilization (1955) and ISOTOPES: A Bibliography of United States Research and Application 1955-1957 (1958). A list of the journals and authors is included.


(It has not been possible to obtain the radioisotopes in the field.)

804 Asperen, K. van, DE TOEPAK. DE NEDONDERZOEK. (The application of isotopes in plant and animal husbandry).

Review article. The section on plant studies on their uptake, transport, and assimilation is at present, 50 refs.

805 Dalm, P. A. STUDIES OF ISOTOPES RADIONUCLIDES IN ANIMALS. (in Dutch).

A review is presented of the use of radioelements relating to medical and veterinary studies. Sections of the observation and study of related animals and the production of new animals. A list of papers and metabolisms of doubly labelled radioelements is included.

806 Dalm, P. A. USES OF RADIONUCLIDES IN ANIMALS. (in Dutch).

A very important and comprehensive analysis of the use of radionuclides and related chemicals, including cereals, nicotine, fumigants, and other substances.
This bibliography contains 1335 selected references on uses of radioactive and stable isotopes in animal husbandry, bacteriology, fertilizer uptake by plants, plant physiology, photosynthesis, and entomology. These references were selected from scientific journals published during 1948-1967. They include those that have appeared in ISOTOPES: A Three-Year Summary of U.S. Distribution (1949); ISOTOPES: A Five-Year Summary of U.S. Distribution and Utilization (1959); and ISOTOPES: A Bibliography of United States Research and Application 1955-1957 (1968). A list of the journals from which the references were selected and an author index are included. (auth.)


This bibliography contains 151 selected references on the uses of radioactive and stable isotopes in animal husbandry and in studies of fertilizer uptake by plants, plant physiology, photosynthesis, and entomology. These references were selected from scientific journals published during the period 1937 to 1958. An author index is included. (auth.)


This bibliography supersedes TID-3516, Suppl. 1. The 148 references cited are those which have appeared in scientific journals published during the period 1957-1958. The section on entomology contains only 7 references. An author and a subject index are supplied.


(1t has not been possible to obtain this publication. It is presumed to contain some references to the use of radioisotopes in the field)

IV - B Surveys

804 Assure, K. van DE TOEPASSING VAN RADIOISOTOPEN IN DE INSEKTENFYSIOLOGIE EN HET INSECTICIDENONDERZOEK (The application of radioisotopes in insect physiology and insecticide research. Landbouw. Tijdschr., Groningen 78 (extra no.) (1958) 669-67. (In Dutch)

Review article. The section on insecticides lists radioisotope-labelled insecticides reported to date, and studies on their uptake, transport and breakdown in plants, and the various lines of research being followed at present, is included.


A review is presented of the fast-growing literature dealing with studies of insects and insecticides employing tracers. The literature has been divided into five broad categories: tagging insects and related arthropods with radiotracers, physiological studies with insects, biological effects of irradiation, studies relating to medical and veterinary entomology, and the preparation and use of labelled insecticides. Summaries of the observations reported in the literature on the use of radiotracers to tag insects and related arthropods and the preparation methods and uses of radioisotope-labelled insecticides and related compounds are presented in tabular form. Experimental results are presented dealing with the distribution and metabolism of doubly labelled (P42 and 32P) Parathion in the goat and the American cockroach. 149 references. (auth.)


A very important and comprehensive review of the whole field. The topics covered are: insecticides (DDT and related chemicals; Lindane and BHC, organic phosphorus insecticides, pyrethrins and piperonyl butoxide, nicotine, fumigants, and miscellaneous insecticidal chemicals), fungicides, herbicides and
plan growth regulators, the tagging of insects, mites, and ticks with radioisotopes, epidemiology and public health, and food preservation and pest control through radiation effects. Special techniques and equipment are mentioned only where they have some bearing on the pest control problem. 323 references.

807 Fisher, W. RADIOISOTOPES IN PHytOPATHOLOGIE UND PFLANZENSCHUTZ. (Radioisotopes in phytopathology and plant protection) NachrBI. druch. Pflichldieges, Berl. 9 (1967) 88-94. (In German)

This review article is divided into two parts. One deals with radiation effects in terms of induced mutations, and the sterilization of food, stored products, pharmaceuticals and packaging materials, with some discussion of radiation sources. The second part is concerned with the use of radioisotopes as tracers as applied in studies on pests, plants and plant protection. 84 references.


Applications of radioisotopes to a variety of entomological problems are reviewed, from 1927 onwards. A type of application is described here which uses isotopes to study phenomena without actually interfering with them. Migration, feeding and breeding habits of many insects have been reported, and studies mentioned on the role of insects in disease transmission, and on predation. Some unpublished work (Hassett & Jenkins) is quoted in which malaria, house, and rockpool mosquitoes, houseflies, fruitflies, and screwworm flies were made radioactive by mixing P32 with the food of the larvae. Cockroaches and flesh flies were injected with gamma-emitting 22Na to study the possibility of locating insects at greater distances than is possible with beta-emitting P32. Canniffe (unpublished) confirmed a suspected mite parasite of the cockroach by introducing P32 into the roaches. P32-labelled mosquitoes and fruitflies were shown (H. & J.) to be caught and eaten by praying mantids (laboratory). - Feeding by mosquitoes on plants was confirmed (H. & J.) by P32-labeling plant juices which were later found to have been absorbed by yellow-fever and house mosquitoes. Some work in physiology is mentioned, including some initial work on labelled inorganic insecticides. Studies on the effects of radiation on growth and reproduction are cited. - 41 references.
PART II

IONIZING RADIATIONS
Langham, W. H., ed., Bell, I. A.
RELATIVE BIOLOGICAL EFFECT
Scientific Laboratory, New Mexico

Numerous references are relevant to establishing appropriate meanings for the ratio of the effect of one rad to another. These references may have been missed in this report. The references are listed in the order given and include those of the author or those that have been reviewed.

* Alexander 1968 - [1165]

810
Amy, R. L. (Univ. Virginia, Charlottesville)
RAYS, GAMMA RAYS AND X-RAY
DESCRIPTIVE STUDIES ON THE PRODUCTION OF PHYSIOLOGICAL EFFECTS
Dis. Abstr. 16, 11 (1965) 284

An appendix to the dissertation
(For abstract, and publication)

811
Amy, R. L. A COMPARATIVE STUDY
DEVELOPMENT IN HABROBRANCHUS

Eggs of Habrobranchus japonicus
were divided into three groups: 

- γ-rays (Co60), or 125,000 rads
- X-rays (moderately high intensity)
- Control

The eggs were exposed at the same level of the beam for all three types of radiation. X-rays were less effective and γ-rays were most effective. The results were consistent with previous findings.

(An abstract of earlier work available)

* Bauern and Muller 1950 - [1165]

812
Bateman, A. J. RELATIVE BIOLOGICAL EFFECTS
INDUCTION OF DOMINANT GENES

*
I RESEARCH

I-A Radiosensitivity

I-A-1 RADIOSENSITIVITY TO DIFFERENT TYPES OF RADIATION

Survey


Numerous references are relevant, in part, to the present bibliography. Results of a literature search to aid in establishing appropriate values for relative biological effectiveness (RBE) are presented. RBE may be defined as the ratio of the dose of 200- to 250-kV X-rays required to produce a specific biological effect to the dose of another radiation required to produce the same level of effect. Although some references may have been missed, the compilation is believed to be relatively complete up to mid-year 1959. The references are listed in alphabetical order, according to author. In most cases, the abstracts given are those of the author or the abstracting medium from which the reference was taken. Approximately 500 references are given.

Alexander 1958 - [1165]


An appendix to the dissertation describes typical embryological development.

(For abstract, and publication of the dissertation in part, see Radiation Res. 3, 2 (1955) 166.


Eggs of Habrobracon juglandis (Ashmead) were subjected, 1-3 h after they were laid, to beta-rays (P32), gamma-rays (Co57), or 250-kV potential x-rays under equivalent physical conditions. At each of the 7 dose levels used, the dose was adjusted so that the amount of energy dissipated within the egg was approximately the same for all three types of radiation. X-rays were most effective in reducing the percentage of eggs hatching, beta-rays and gamma-rays were less effective and gamma-rays were least effective in this respect. Histological observations made on embryos exposed at the highest dose level are described. Enlargement of nuclei (up to 3 times the diameter of those found in untreated animals) was a prominent feature of the degenerative changes observed. Although there was indication that cell division continued for a time after exposure, other developmental processes were for the most part completely inhibited. Externally visible structural derangements were seen in damaged eggs but none which were interpreted as being peculiar to any of the types of radiation employed. In general, the time between irradiation and the appearance of visible signs of injury was inversely proportional to the amount of radiation received by the eggs. (auth.)

(An abstract of earlier work appeared in Anat. Rec. 115 (1953) 273)

Baumer and Muller 1952 - [1169]

Bateman, A. J. RELATIVE MUTAGENIC EFFICIENCY OF 4 MeV X-RAYS AS ASSESSED BY THE INDUCTION OF DOMINANT LETHALS IN DROSOPHILA. p. 144-9 (Disc. 149-55) in "Progress in Radio-

199

There are indications that the Linear Accelerator (4M eV MeV) is less efficient than the conventional Resonex (500 keV), at least as regards its mutagenic effects on Dro sophila.


Production of mutations and lethal dominants are always proportional to the dose administered. The relative efficiency is 9.83. (BS 19: 1055, 1958)


The authors report about comparative investigations on the induction of mutations in Drosophila by fast electrons of a betatron and by conventional x-rays. The rates of radiation-induced, sex-linked recessive lethal mutations were determined on the basis of the Muller-Schuler method. Under the described conditions of equivalent doses (3000 and 3000 resp. rays) 15 MeV electrons and 2000 KV x-rays were found to produce the same mutation rates within the range of statistical error. The relative biological effectiveness of the betatron electron is approximately 1. (auth.)

815 Brandt and Höhne 1952 — [1972]


In studying the mutagenic activity of fast electrons from a 6-MeV betatron it is shown that, as concerns the elicitation of recessive sex-limited lethal factors in D. melanogaster, there does not exist a significant difference between fast electrons and the x-rays conventionally used for therapeutic purposes. For mature male germline cells as well as for immature germ-cells, the relative biological activity is 1. If equal doses are applied, then the rate of mutation induced in mature or in immature germ-cells lies considerably below that induced in mature male germline cells. (CA 47: 6969A, 1960)


Since the rate of radiation-induced chromosome mutations depends very considerably on the stage of development of the irradiated gametes, translocations were only considered for mature sperm, with copulation limited to one day. Dosages used for both types of radiation (3 MeV electrons and 200 KV x-rays) ranged from 1000 r 6000 r. The percentages of I/II translocations induced in D. melanogaster were tabulated. The results of the study were discussed. The effectiveness of fast electrons relative to x-rays was found to scarcely deviate from 1.

817 Brandl, H. von, Dittrich, W. INDUIZIERTE BRÜCHE DES RING-CHROMOSOMS X² von DROSOPHILA MELANOGASTER NACH BESTRAHLUNG MIT BÖNTENSTRAHLEN UND SCHNELLEN ELEKTRONEN (Induced breaks of the X² ring chromosome of Drosophila melanogaster after irradiation with x-rays and fast electrons). Strahlentherapie 111 (1955) 149-56. (In German, but see ABC-v. 547, p. 12p.)

Males of an X² strain of D. melanogaster were irradiated with various doses of fast electrons from a 0-MeV betatron and with x-rays (180 KV). Immediately after irradiation the males were bred with Berlin normal females. The F1 generation produced by fully-developed spermatocytes exhibited a more or less marked deficit of females, the investigations covering a total of 330 000 flies. The results were compatible with the assumption of a linear increase of the deficit of females with dosage within the dosage range investigated, from 0 to 6000 r. The x-ray experiments made it at least highly probable that the effect increases with the dose for x-rays, and the same holds true for fast electrons in the more highly scattering electron experiments. No difference in the action of the two types of rays could be found. The ring-X method is not very suitable in the form employed here for a more precise comparison of the biological activity of different types of ionizing rays. (auth.)

818 Dittrich et al. 1950 — [889]


It has been shown that fast neutrons and x-rays are considerably more effective than slow neutrons. Since the fast neutrons produce a much more rapidly than one would expect from simple recoil and fission processes, it is concluded that the frequencies of fast neutrons and x-rays as compared to fast neutrons are significantly different. The results of experiments with x-ray-induced mutations are presented.

819 Edgington, C.W., Randolph, J. EMBRYOLOGY OF THE GRASSHOPPER. (Drosophila melanogaster) Embryogenesis and development. (In German)

An investigation was made of the zygotic induction of dominant lethal mutations in Drosophila. These results show that the induction of dominant lethal mutations in Drosophila is of different average lifetime in the egg, and may be used as a test of the induction of both genetic effects and a test of the induction of dominant lethal mutations in Drosophila. (auth. summary)

820 Evans, T.C., Yu Ying Po. EMBRYOGENESIS OF THE GRASSHOPPER. (Drosophila melanogaster) Embryogenesis and development. (In German)

An investigation was made of the zygotic induction of dominant lethal mutations in Drosophila. These results show that the induction of dominant lethal mutations in Drosophila is of different average lifetime in the egg, and may be used as a test of the induction of both genetic effects and a test of the induction of dominant lethal mutations in Drosophila. (auth. summary)

821 Frey, E. STRAHLENWIRKUN (Radiation effect of a 31-MeV electron beam) 191-208. (In German)

Lethal dose curves were established for x-ray. In 31-MeV electron beams the eggs of D. melanogaster were irradiated with x-rays. The results were compatible with the assumption of a linear increase of the deficit of females with dosage within the dosage range investigated, from 0 to 6000 r. The x-ray experiments made it at least highly probable that the effect increases with the dose for x-rays, and the same holds true for fast electrons in the more highly scattering electron experiments. No difference in the action of the two types of rays could be found. The ring-X method is not very suitable in the form employed here for a more precise comparison of the biological activity of different types of ionizing rays. (auth.)

822 Fritz-Niggli, H. ERSTE BIOLOGISCHE EXPERIMENTE MIT 31-MeV BETATRONSTRAHLUNG VON DROSOPHILA MELANOGASTER PUPA. Die 31-MeV electron beam was used to irradiate the pupae of Drosophila melanogaster pupa. The effects of 31-MeV electron beam on the pupal development are described.
Dittrich et al. 1950 - [899]

818


It has been shown that fast neutrons are 1.65 times more effective than Ca$^+$ x-rays in inducing sex-linked recessive lethals. Since the frequency of recessive lethals induced by x-rays increases with increasing dose more rapidly than one would expect on the basis of linearity, the relative biological effectiveness for x-rays as compared to fast neutrons or gamma rays is dependent upon the dose of x-rays used. It was also shown that the frequencies of recessive lethals induced by x-rays in acrocentric- and a ring-X chromosome were significantly different. The possible reasons for this ring-X difference and the non-linear dose response for x-ray-induced recessive lethals are discussed. (auth.)

819


An investigation was made of the effects of monochromatic 14-MeV fast neutrons and Ca$^+$ gamma rays on the induction of dominant lethals and of 14-MeV neutrons on the production of sex-linked recessive lethals in Drosophila. These results were compared with those of other reports from this laboratory, in which radiations of different average LET were used. It was shown that the LET of different radiations for the induction of both genetic effects studied is dependent on the LET of the radiation used. 34 references. (auth. summary)

820


Eggs of Melanoplus differentialis were irradiated on the 4th day of development (25°C). They were examined 3 weeks later, at which time the control were in the dispaus stage. Radiation effect was estimated as either injured or complete destruction of the embryo. X-ray doses were from 100 r to 450 r in increments of 50 r. Two sources of fast neutrons were utilized. The first was the direct beam of the Argonne 60-in cyclotron and was produced by bombarding a beryllium target with deuterons. The second was a field at the rear of the target (190° from first field utilized). The second irradiation field differed from the first in including lower energy neutrons, and the intensity was lower by a factor of 2. Exposures were measured in air with thimble ion chambers. Neutron doses in rep were calculated by a conversion factor based on studies employing different methods of measuring neutron dose. The results of two experiments were consistent in that the LET for the x-radiation was 265 and 267 r; for the higher energy neutron beam 133 and 112 rep; and for the lower energy neutron beam 63 and 49 rep. Based on the 260 keV potential x-radiation as unity, the LET of the higher energy neutron beam was 2 to 2.3 and that for the lower energy beam was 4.2 to 5.5. So far, the results of another criterion (that of complete destruction) have given similar conclusions in that the relative effectiveness appears of the same order. Attempts to determine whether qualitative as well as quantitative differences exist are now being investigated.

821

Frey, H. STRAHLENWIRKUNG EINES 31-KEV BETATIENS AUF EIER VON DROSOPHILA MELANOGASTER (Radiation effect of a 31-keV betatron on the eggs of Drosophila melanogaster). Oncologia 4, 4 (1953) 191-203. (In German)

Lethal dose curves were established in eggs of various ages and compared with that caused by 180 keV x-radiation. In 3-h eggs 31-MeV radiation was less effective than the x-rays or the fast electrons of 3 MeV. In 4-h eggs the curves of 3-MeV and 31-MeV coincidence, both being less effective than x-rays. In 7-8 h eggs 31-MeV radiation is less effective than 3-MeV, both being less effective than x-rays. (BA 26: 20992, 1953)

822

Fritz-Niggli, H. ERSTE BIOLOGISCHE VERSUCHE MIT DEM 31-MEV BETATIEN (First biological experiments with a 31-Mev betatron). Arch. Klaus-Stift. Versuchsanst. 50 (1951) 404-9. (In German)

Drosophila melanogaster pupae of various ages were subjected to 50- and 180-keV and 31-MeV radiation. Pupae of 5 h, 15h, 22h and 48 h were given doses of 12 000 r, 30 000 r and 80 000 r. Relative developmental changes are described briefly.

201
Fritzi-Niggli 1955 - [1186]

Fritzi-Niggli 1955 - [1186]


Non-irradiated females of Drosophila melanogaster mated with irradiated males (2000 r) lay eggs which show different rates of hatchability depending on the time after treatment. The peak of reduced hatchability lies between the 5th and 7th day. This effect must be caused not only by dominant lethal factors but also by a lack of normal active sperm. Histological studies show that spermatocytes and spermatogonia are resistant to irradiation. On the other hand, the stage during late spermatogenesis is very sensitive. 31 MeV photons are less effective than 180 kV photons. (See summary)


The tests described consisted of determining the percentage of unhatched embryos in different periods after irradiation of the male parents. This and data from other tests proved the effectiveness of 30-50 MeV electrons and 31 MeV x-rays from a betatron in inducing dominant lethals as compared with ordinary x-rays. Four strictly marked stages of spermatogenesis with different reaction patterns were distinguished. A strict dependence of RBE (relative biological effectiveness) on the age of irradiated gametes and also on dosage can be observed.


It is well known that the number of certain mutations depends on the developmental stage of the irradiated germ cells. In the hope of elucidating this differential sensitivity, there were irradiated sperms of Drosophila (in adult males) spermatids (in 48 h pupae and adult males), spermatocytes (in 0-2 h prepupae and adult males), spermatogonia (in 4 h larvae and adult males), in N₂, air, O₂, CO₂, etc. Experiments were also carried out with radiations of different ionization densities (180 keV- and 31 MeV-photons, 10 and 30 MeV-electrons). The production of visible mutations, recessive and dominant lethal factors, chromosome losses, gynandromorphs, and translocations was tested. Fitted the most radiosensitive stages (spermatocytes and spermatids) are very sensitive to a reduction of oxygen tension, whereas mature sperms show little response. The pronounced effects of other chemical factors are also discussed. A strict dependence of relative biological effectiveness upon the age of the irradiated gametes and also upon the dosage can be observed. There is no manifest influence of varying radiation qualities upon the relatively radioreistant stage of sperms, whereas in spermatids and specifically spermatocytes, the high-energy radiations are less effective. The following problems are discussed: Whether the differential sensitivity of sperms, spermatids and spermatocytes may be due to different oxygen tensions (depending on the cell function) and whether in different stages there are two types of induction of mutation (by the OH-H radicals and H₂O₂).


Drosophila males were irradiated with 180 keV x-rays, 31 MeV γ-rays, and 30 MeV b-rays from a betatron. When developing sperm were irradiated quantitative differences could be observed. The lower-energy radiation (180 keV) proved more effective in terms of translocations and chromosome breaks. Such differences were not observed on irradiating mature sperm where one assumes that it is mostly the free radicals which are effective whereas H₂O₂ plays a highly active part in developing sperm. The life time of free radicals and the production of H₂O₂ will depend on linear energy distribution (ionization density) which will differ with the type of radiation employed.


Dissected 14-day-old embryos of some to 255 kV potential x-rays and 70.4 rep of 5-rays was used for types of radiation. The embryo's placed at 30°C. At intervals of 10 min and stained. Cells in late ana, and the number of single fragments number of 5-rays induced double was greater than the number of statistically signifi at the 0.05 level after it was effectiveness of the two type.


14-day-old embryos of Chortops preparations. Some were exposed to different conditions for exposure being identical doses of radiation were used, rates were adjusted so that the same for both types of radiations followed irradiations maintained at 38°C. The number of survivors was recorded every 22 minutes for different doses of radiation used. The period of time can be determined with respect to the extent to which the cells recover after treatment significant at the 0.05 level.

(A abstract was also published 1955. 1 p.)


In tests using Drosophila, 50% 1954.

Gleimobitzky et al., 1960 -

Grosch, D.S., Sullivan, R.L. NUCLEOGENE 19, 12 (1957) 63.

In reactor and certain accelerators, the additive effects of such as that of external x-rays and gamma-rays (NASA 12: 2868, 1958)

Dissected 14-d-old embryos of *Chortophaga viridisfactoria* were exposed to 1.7 MeV ß-rays from ²⁶²*Fe* and some to 125 kV potential x-rays, conditions for exposure being identical in both cases. A dose of 64 r of x-rays and 70.4 rep of ß-rays was used, the amount of energy dissipated in the tissue being equal for the two types of radiation. The embryos were made into hanging drop preparations following irradiation and placed at 30°C. At intervals of 44, 220, 264 and 352 minutes after irradiation the embryos were fixed and stained. Cells in late anaphase and very early telophase were examined for chromosome fragments and the number of single fragments produced were the same in both x-rayed and ß-irradiated cells. The number of ß-ray induced double fragments observed in cells fixed 352 minutes after irradiation, however, was greater than the number observed in x-rayed cells, fixed at the same interval. This difference was statistically significant at the 0.02 level. Since the mutator rate of ß-irradiated cells differs from that of x-rayed cells, the difference observed in frequency of double fragments may be due to the fact that cells analyzed 352 minutes after irradiation were treated in different stages of mitosis and not due to a difference in effectiveness of the two types of radiation in producing fragments at one stage of mitosis.

(Entire report. Abstract of paper for Atlanta meeting of Association of Southeastern Biologists, April 18-19, 1962)

(An abstract was also published in J. Tenn. Acad. Sci. 27 (1952) 211)

14-d-old embryos of *Chortophaga viridisfactoria* were removed from eggs and dissected as for hanging preparations. Some were exposed to 1.7-MeV ß-rays from ²⁶²*Fe* and some to 125-kV potential x-rays, conditions for exposure being identical in both cases (Gaulden, Sheppard and Cembor, Nature 189 (1952) 228). Two doses of radiation were used, namely, 8 r and 64 r of x-rays and 8 r and 70.4 rep of ß-rays; dose rates were adjusted so that the amount of energy dissipated in the tissue at a given dose level would be the same for both types of radiation. The irradiated and control embryos were made into hanging drop preparations following irradiation and the neuroblasts observed with a microscope enclosed in an incubator maintained at 38°C. The number of cells in mid-mitosis (prometaphase, metaphase, and anaphase) was recorded every 22 minutes for 6 h. Twenty-two minutes is the average duration of mid-mitosis and the doses of radiation used do not affect it, consequently, the number of cells going through mitosis in a given period of time can be determined. At both doses x-rays and ß-rays affect mitotic activity similarly with respect to the extent to which it is depressed but differently with respect to recovery - a greater number of cells recover after treatment with ß-rays than with x-rays. This difference in recovery is statistically significant at the 0.02 level.

(Entire report. Abstract of paper for Atlanta meeting of Association of Southeastern Biologists, April 18-19, 1962)

(An abstract was also published in J. Tenn. Acad. Sci. 27 (1952) 211)


In tests using *Drosophila*, 50% of the eggs were killed by 240 r y-rays or 210 r x-rays. (EM 14, 6: 1938, 1952)

Glembochtzky et al, 1960 - (1963)


In reactor and certain accelerator situations radiations is often present as a mixture of radiations. To study the additive effects of such mixtures, a series of experiments was made on the combined sterilizing effects of external x-rays and ingested ß-radiation (²⁶²*Fe* and Sr⁹⁰) on the ectoparasitic wasp, *Habrobracon juglandis*. (NRA 12: 2806, 1958)

The relative biological efficiency of fast electrons is compared to 200 kV x-rays, and data presented for 3-, 4- and 5-1/2 old Drosophila eggs and chrysaelae.


First meiotic metaphase eggs of Habrobracon were used to test the comparative effectiveness of 124 kV and 50 MeV x-radiation. Dosages ranged from 100 r to 1750 r for low-voltage work and from 100 r to 1500 r for high-voltage study. Failure of unfertilized eggs to hatch has been attributed to the presence of dominant and, to a lesser extent, of recessive lethals. Dose action curves are approximately exponential. Test for difference between the slopes of the two curves showed these to be plotted and fitted on a semi-logarithmic scale revealed no statistically significant difference. Variance analysis of data within dose and for each voltage of radiation used showed that the data for each dosage appeared to be conforming to the same information from experiment to experiment. Comparisons between data for 124 kV and 50 MeV indicated that for a given dosage radiations of low and high voltage were revealing similar effects. A review of previous work by Whiting, on which the method was based, has led to the conclusion that x-ray radiation induced chromosome breakage, terminal deletions, and the formation of chromosomal bridges in most of the eggs which died. These dominant lethals were mainly responsible for failure of eggs to hatch as larvae. It is concluded that equivalent x-ray dosages from 124-kV and 50-MeV machines appear to be equally effective in inducing lethals in Habrobracon eggs treated in first meiotic metaphase.

This study was reported in detail in the Amer. J. Roentgenology 74 (1955) 677-85.


An abstract of this paper was published in Radiation Res. 1 (1954) 499.


D. melanogaster was exposed to a 3-MeV electron beam and to 2000 kV-x-radiation, such as is generally used in therapy, for the purpose of studying the effect of these radiations on chromosome mutations. With regard to the reciprocal translocations between the second and third chromosome that were covered by the analysis of the crossing over, it was found that the increase in the rate of mutation induced by the radiation was a little greater than proportional to the dose. No differences were found between the effects produced by these two radiations of unlike differential ionization. (auth.)

(Also available in English. cf. AEC-TR-3474, Atomic Energy Commission, Washington, D. C., 11 p.)


Part of this work was published subsequently in Radiation Res. 4 (1956) 65.

Kayhart, M. A COMPARATIVE STUDY OF DOSE-ACTION CURVES FOR VISIBLE EYE-COLOUR MUTATIONS INDUCED BY X-RAYS, THERMAL NEUTRONS, AND FAST NEUTRONS IN MARMONIELLA VITRIPPINUS. Radiation Res. 4 (1956) 65-76.

Virgin female wasps (70-449) were treated with a series of doses of x-rays, thermal neutrons, and fast neutrons. They were then unmated, and their haploid sons (75-459) examined for bright-eye-colour mutants. Dose-action curves for proficiency of visible eye-colour mutations by each of these three radiations were obtained. The shape of the curves is similar; each shows an initial linear portion and then a rise more rapid than that calculated for proportionality. It is suggested that the mutations occurring at the lower doses, forming the linear part of the curve, are due to singlehits, and that each of the two-hit mutations (small deletions and inversions) increases rapidly at the higher doses, causing the curve to rise steeply. The neutron data adequately fit this one-hit-two-hit hypothesis, but in spite of the general resemblance of the three curves the x-ray data do not. With visible eye-colour mutations in Marmonella as a criterion, the relative biological efficiency at higher doses is to be expected if many of the visible mutations were due to mispair rearrangements and deletions. (auth.)


Short-cut formulas are given for three cases: (i) x (ii) c (iii) c from a formula which is a function of the number of controls that permits the construction of such table by computer. In some experiments which compare plants (Chlorella vulgaris) or insects (Drosophila melanogaster) for their response to different treatments, the data may be represented in a table with columns headed "control", "treatment 1", "treatment 2", etc. Each column contains a number of observations. The problem is to find the treatment which gives the largest or smallest value. The solution is given in the form of a table, the entries of which are the results of applying the formulas to the data. (auth.)


Insect eggs were exposed to an x-ray source at a distance and with an intensity of (i) y- and b-radiation (i) partial irradiation. In each case the single dose was studied and the study is recovery in this study. The recovery of an optimal duration for recovery.

Löbbecke und Müller 1959 -
Löbbecke und Müller 1960 -
Medical Research Council 1960 -


Fast neutrons from the Oak Ridge nuclear research reactor (about 1 MeV) are approximately 1000 times more effective than X-rays in the third chromosome of Drosophila. Such mutations are produced at a rate of 2-10^-6 for all observed variants being visible in the eye, giving a relative biological effectiveness of about 1000 times that of X-rays. It appears, therefore, that the x-rays are more effective than the neutrons. The results of this study are given in Table 1.

(An abstract of earlier work "Visible and invisible mutations in Drosophila melanogaster" published in Genetics 58 (1959) 915-25.)


Mature sperm of D. melanogaster. Co60 gamma rays of 2000 kV per p.m. were used to the type of virgin and those Minutes were detected in the control group statistically from those induced per unit of dose in producing the effects of these agents approx. density of the path.
TIVENESS OF X-RAYS OF 124kV (664) 489.

The parative effectiveness of 124 kV and higher work and from 100 to 1500 r attributed to the presence of rays are approximately exponential, e plotted and fitted on a semicircle analysis of data within dose appears to be conveying the bi data for 124 kV and 50 MeV in revealing similar effects. A as led to the conclusion that formation of chromosomeal bridges possible for failure of eggs to hatch and 50 MeV machines appear to be at metiotic metaphase. (5,6) 677-85.

TIVENESS OF KOREN GENES OF Y 72 (1955) 677-85.

FATIONEN SEI DROPHOGLA
HUN (Induced chromosome - Strahlentherapie 24 (1954) 72-8.

In and to 200-kV x-radiation, such these radiations on chromosome no and third chromosome that increase in the rate of mutation e., No differences were found in the study of dose-action curves, neutrons, and fast 1460-1.

4 VISIBLE EYE-COLOUR MUTA-
TIONS IN MORMONIELLA

thermal neutrons, and fast neutrons, for bright eye-colour mutants. Dose-cumulative and lineare radiations were obtained. The shape is more rapid than that calculated linearly, forming the linear part of dose (small deletions and inversions), the neutron data adequately fit this one-curve the x-ray data do not. With biological efficiency at higher doses is seen and deletions. (auth.)


Short-cuts formulas are given which permit the exact partition of chi-square from an r x c contingency table into (r-1) x (c-1) individual degrees of freedom. Each single degree of freedom chi-square is computed from a formula which is a function only of the observed frequencies. A general expression is given which permits the construction of such formulas for contingency tables of any order. The method is applied to some experiments which compare the effects of x- and S-radiation on mitotic rates in grasshopper neuroblasts (Chromaphtex variifasciatus). (auth.)


Insect eggs were amongst the various types of biological material subjected to various doses of x-radiation, mixed y- and S-radiation (233) and pure S (234). The insects were Bombus rufipes and Bacillus subtilis (subtilis). Two sets of experiments were made for testing recovery following (1) total irradiation, and (2) partial irradiation. In each part, recovery was made evident by (a) the study of massive irradiation in a single dose and (b) the study of fractionated irradiation. In addition, the effect of cold on recovery was studied for insect eggs. Results are illustrated by graphs and discussed. Cold did not completely eliminate recovery in this study. The time during which the cold acts appears to have a certain influence, the existence of an optimal duration for the action of cold being observed, which corresponds to the optimal interval for recovery.

* Lobbecke and Muller 1959 - [1025]

* Lobbecke and Muller 1960 - [1292]

* Medical Research Council 1957 - [1054]


Fast neutrons from the Oak Ridge National Laboratory 86-inch cyclotron and from nuclear test devices (about 1 MeV) are approximately four times as efficient in producing specific loci mutations at the red markers in the third chromosome of Drosophila melanogaster as are x-rays of 250 kV potential. Dominant visible mutations are produced at a much higher rate per rep of neutrons than per r of x-rays, the RBE of neutrons for all observed variants being from 6 to 37 and for the proved dominant mutations from 3 to 52. The relative biological effectiveness of fast neutrons as compared to x-rays in the production of dominant mutations likewise is quite high. Contrary to reports of previous investigations that fast neutrons are only about two-thirds as effective as x-rays in producing sex-linked recessive lethal mutations, it was found that the neutrons have an RBE of 2. Dominant lethals are produced at a much higher frequency per rep of fast neutrons than per r of x-rays, the RBE at lower doses being about 7 and at higher doses falling off to about 4. It appears, therefore, with all the biological criteria used to measure the genetic damage of radiations in Drosophila, that fast neutrons cause a much greater effect than do x-rays. (auth.)

(An abstract of earlier work "Comparison of rates of visible mutations produced by fast neutrons and by X-rays at specific loci in the third chromosome of Drosophila melanogaster" by Mickey and A.F. Yandres was published in Genetics 35 (1953) 676-71)


Matute sperm of D. melanogaster (Oregon-R) were given doses ranging from 1500 to 9000 r of either Co60 gamma rays and 260 kV potential x-rays or from 250 rep to 5000 rep of fast neutrons. Treated males were mated to wild type virgins and transferred to fresh cultures each day through four cultures. The dominant Minutes were detected in the F1 flies. Rates of Minutes induced by these high energy x-rays did not differ statistically from those induced by gamma rays. The fast neutrons, however, were much more efficient per unit of dose in producing Minutes; their RBE was about 4.5. Measured in terms of Minutes induced, the effects of these agents appear to be directly proportional to dose and also related to specific ionization density of the path.

The average number of offspring/male/day of irradiation with 2500 r and 500 r of 175 keV x-rays is plotted. Both curves show a typical increase from the 1st to the 2nd day (particularly where newly emerged males are used) associated with a slight decrease in recessive lethals. The curves fall, more sharply with higher doses, to a practically sterile period of varying length, depending on dose. The percentage of sex-linked lethals after irradiation at 31 MeV and 175 keV (1900 r and 2000 r) are given, also the RBE curves. On the whole, the RBE is lowest during the period of highest mutational sensitivity.

Mossige, J., Obredal, P. ON THE CONSTANCY OF THE RELATIVE BIOLOGICAL EFFICIENCY OF B-

An apparatus for external irradiation of flies by β particles from a solution containing radioactive isotopes is described, and the biological dosimetry of the source is reported. The apparatus has been used for obtaining the sex-linked recessive lethal mutation curve after irradiation with 35S β particles, using a dose biologically equivalent to 900 r for the induction of dominant lethals in mature sperm. The curve was found similar to the one obtained after 1900 r of x-rays. (auth.)

Müller, H.J. CHARACTERISTICS OF THE FAR STRONGER BUT "SPOTTER" MUTAGENICITY OF FAST NEUTRONS AS COMPARED WITH X-RAYS IN DROSOPHILA SPERMATOGENA (abstr.). Genetics 50 (1954) 985.

Experiments of 1953 establish frequency of translocations connecting second and third chromosomes at approx. 0.3×10^-7 per rep, practically independently of dose, for neutrons from either the Oak Ridge cyclotron or pile, applied to mature spermatozoa in young males. This effectiveness is 2.4 times that of 4000 r x-rays, varying with x-ray (dose)^1/4. - NXX (neutron:x-ray effectiveness) in inducing male exceptions, lacking either paternal sex-chromosomes or its marked portion, was 3-5. However, subtraction of partial losses, estimated by test, indicated that NXX for complete losses, presumably representing bichromatic bridges derived from individual breaks, was about 7. Causes of lower NXX for euchromatic rearrangements than for individual breakages are listed. - NXX for producing separately registered sex-linked recessive lethals was 2.4. However, for all visible changes of expression of specific loci, NXX was about 4, as it was for proved "point-mutations" of these loci (this holds also for female germ cells). This difference from lethals is caused by multiple neighbouring effects with neutrons, which hide some third of point-mutational lethals, yet cause neutron-induced rearrangements to affect more loci (hence to give more "visibles") than x-ray-induced rearrangements. (from abstr.)

* Naville 1955 - [104J]

* Paul and Schubert 1950 - [105J]

* Regelbr et al. 1950 - [106J]


The comparison of the biological effectiveness of 35S β radiation and 70-keV γ radiation was made for three biological specimens; the specimens were fruit fly eggs, pea sprouts, and the tops of the sprouts of VI. faba. A large number of batches of fruit fly eggs, specially prepared and incubated, were irradiated with 70-keV x-rays and 35S betas. One set of batches was irradiated after 2 h of incubation and another set after 3 h. The number of irradiated eggs hatched after 48 h was in each case compared with an unirradiated control batch. A plot of fertility vs. dose was thus obtained for each case. The 1-h incubated eggs were much less resistant to radiation than the 3-h eggs. A value of 1.0 for the RBE of 35S betas was obtained with the former and 0.85 with the latter by comparing the β- and x-ray doses required to produce a 50% fertility.
and 500 r of 175 keV x-rays is
say practically where newly
lithal. The curves fall, more
ly, depending on dose. The per-
(1000 r and 2500 r) are given, also
highest mutational sensitivity.

BIOLGICAL EFFICIENCY OF 8-
RITER, p. 245-52 in "50th Anniver-
sheng and Co. (W. Nygaard).

mutation containing radioactive isotopes
apparatus has been used for obtain-
7- particles, using a dose
mature sperm. The curve was

RITTER" MUTAGENICITY OF FAST
GAMMA (abstr.), Genetics 59 (1964)
second and third chromosomes at
ions from either the Oak Ridge cyclac-
tivity in 4.4 times that of 4000 r
nent in inducing male exceptions,
. However, subtraction of partial
unusually representing biocorrelated
X-rays for eucenic rearrangements
sex-linked recessive lethals
, N2E was about 4, as it was for
cells). This difference from lethals
third of point-mutation lethals, as
give more "visibles" than x-rays.

The statistical uncertainty of these two determinations did not clearly establish
at the different values for 8- betas
was different from 1.0. It did, however, in measurements of rate of growth of the
spotted specimens. The doses required to reduce the rate of growth by 50% yielded a
values of 8-R for 8- beta
through experiments in the realm of human pathology, and that concrete experimental
must be chosen and clearly stated in determining the 8-R in biological radiation-damage
as well as in medicinal methods. (NSA 15: 13904, 1961)

846 Rinner, W. L., Kelly, E. M. RADIATION DOSE RATE AND MUTATION FREQUENCY. Science 128
(1958) 1545-50.

New data have clearly confirmed the earlier finding that specific locus mutation rates obtained with chronic
r-irradiation of spermatogonia are lower than those obtained with acute x-rays. Since this result is in con-
tact to classical findings for Drosophila spermatogonia, and apparently contradicts one of the basic tenets of
radiation genetics, it was important to determine the factors responsible for it. Experiments undertaken for
this purpose reveal the following: the lower mutation frequency is due mainly to difference in dose rate of
radiation, rather than quality; a dose-rate effect is not obtained in experiments with mouse spermatogonia,
confirming classical findings for spermatogonia, and indicating that the explanation for intensity dependence
in spermatogonia resides in some characteristic of gametic stage, and a dose-rate effect is found not
only in spermatogonia but also in oocytes, where cell selection is improbable, indicating that the radiation
intensity effect is on the mutation process itself. A threshold response for all mutations in spermatogonia
and oocytes is not a necessary consequence of the findings. Plausible hypotheses consistent with the present
results can lead to other predictions. From a practical point of view, the results indicate that the genetic
hazards, at least under some radiation conditions, may not be as great as those estimated from the mutation
rates obtained with acute irradiation. However, it should not be forgotten that even the lower mutation
rates obtained with present intensity levels are still appreciable. (auth.)

846 Schmid, W. VERGLEICH DER GENETISCHEN WIRksamkeit DER 31-MeV-BETATRONSTRAHLUNG MIT
300 keV-RONTGENSTRAHLUNG DURCH ERZEUGUNG VON SICHTBAREN REZESSIVEN MUTATIONEN UND
BEI DROSOPHILA MELANOGASTER (Comparison of the genetic effectiveness of radiation from a 31 MeV
betatron and 300 keV x-rays in terms of the production of visible recessive mutations and gynandry in
Drosophila melanogaster). Oncologia 11 (1958) 218-43. (In German)

In order to compare the biological efficiency of the 2 sources, some normal Drosophila males from a wild
infed strain were subjected to 3000 r of 8-radiation (31 MeV) and others to an equal dose from a conven-
tional x-ray source (300 keV). Similar experimental conditions were ensured. After mating with females
homozygous for 5 factors, the descendents were examined for radio-induced visible, recessive mutations.
Values for mutation rates and the number of XO-males and gynandry were found to be of the same order.
There appeared to be no essential quantitative difference in the genetic effects of the two qualities of
radiations used.

847 Shenfield, A. J. DIE ERZEUGUNG VON REZESSIVEN GESCHLECHTSGEBUNDENEN LETALPAKTOREN BEI
DROSOPHILA MELANOGASTER DURCH SCHNelle 30-MeV-ELEkTRONEN UND DURCH 180 keV RONT-
STRAHLungen (The response of sex-bound lethal factor in Drosophila melanogaster to irradiation by 30-MeV
electrons and 180 keV x-rays). Oncologia 10 (1957) 281-94. (In German)

The relative effects of 180 keV conventional rays and of fast 30 MeV electrons, both at 3000 r, were
investigated on immature male germ cells of Drosophila melanogaster which were irradiated 5-11 d before
fertilization. The Muller-6 method was employed, and the lethal and sublethal factors resulting in the F1
generation were counted. Using fast electrons, 6.07% lethal factors were obtained, compared to 5.18% with
conventional rays, i.e., the mutagenic effect of fast electrons was 1.17 times stronger. This difference,
however, could not be verified statistically. The number of sublethal factors produced was too minute for
quantitative evaluation. It may be presumed from the experiments that fast 30 MeV electrons possibly have
a stronger mutagenic action than 180 keV roentgen rays. (auth.)

* Stone et al., 1954 - [1068]
* Sullivan and Gennes 1953 - [1105]
RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS, GAMMA-RAYS, X-RAYS ON GRASSHOPPER Nymph Ovarioles (MELANOGAstra INDIFFERENTIALES).


Fifth or sixth instar grasshopper nymphs were used. In order to destroy every egg in each grasshopper ovariole, with the exception of the most advanced, it was necessary to irradiate the total body with 350 r (200 kV) x-rays, 420 r Co gamma rays, or 32.5 rep of fast neutrons. Thus, the relative biological effectiveness of Co gamma rays: 200 kV x-rays: 420 r Co gamma rays: 32.5 rep of fast neutrons, for this specific effect, is 1:0:1.2:1.9. This is correlated with relative specific ionization and linear energy transfer. It is suggested that damage to the grasshopper ovariole could be used as a biological dosimeter for fast neutron doses in the range 10-25 rep. The high anabolic rate in the formation of the grasshopper egg within the ovariole may well be a major cause for its sensitivity to ionizing radiation.

RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS AND Co-60 GAMMA RAYS.


During the past several months, the Neutron Radiobiology group at Argonne National Laboratory has had the opportunity to test various organisms in a gamma/neutron chamber. Comparisons of the relative biological effectiveness of the two radiations have been made for a variety of biological materials, including the incidence of chromosomal aberrations in Drosophila melanogaster and the destruction of egg nuclei of grasshopper (Melanoplus differentialis) nymphs.


Experiments on the biological action of intermittent (so-called "ultra-fractionated") roentgen irradiation showed that the effects become noticeable only when the elementary periods of irradiation and intermissions are very small. The effect, which is a weakening of the x-ray action as compared with that of a continuous treatment, can exceed 50%. As a working hypothesis, it can be supposed that the effect of a quantum hit within the limits of an elementary target is living cell last for a certain time interval, if another hit reaches the same target before the expiration of that interval, the effect is increased, that is the case of a continuous irradiation. Experiments with 12-h-old Drosophila pupae showed that the width of elementary targets is at least 0.1 mm (10 to 100 cells), and that the hit effect lasts for about 1/300 s. (auth.)

RADIOBIOLOGICAL ADDITIVITY OF VARIOUS IONIZING RADIATIONS.


A discussion is presented on the problem of additivity of various types of ionizing radiations. A summary is included which outlines the degree of additivity found in various experiments by the author and others through combinations of x-, gamma-, fast-neutron and x-rays on the mouse, bean roots, Drosophila eggs, Drosophila pupae and the human skin. It is concluded from the analysis of these studies that complete additivity of two types of radiation indicates some difference in mechanism of action of the radiations. Complete additivity indicates that the mechanisms of action of the radiations are identical in their most essential feature, the promotion of the same determinative events (one of a succession of unknown relevant events leading to the production of the known biological effects), but are not necessarily alike otherwise. It is concluded that it is probably wise to assume that additivity of fast-neutrons and gamma-rays is the complete type. (NSA 4: 2142, 1950)

COMPARATIVE LETHAL ACTION OF X-RAYS AND CYCLOTRON NEUTRONS ON DROSOPHILA EGGS.

CH-3904, Univ. Chicago Metallurgical Laboratory, Dec. 1950, 6 p.

The x-rays were generated at 200 kV and 5 mA and were filtered by 0.5 mm of Cu and 1 mm of Al. The target-to-object distance was adjusted to give a dose rate of about 10 r/min. The fast neutrons were generated by 8 MeV deuterons impinging on a beryllium probe in the University of Chicago cyclotron. The eggs were exposed in a leadwalled chamber which was so constructed that radiation directly from the probe was filtered through 4 inches of lead, while scattered radiation from other directions was filtered through at least 2 inches. Various lots of eggs were given graded doses of x-rays, of fast neutrons, and of mixed neutrons and gamma radiation. The LD of x-rays is 170 r, that of fast neutrons is 31 n, and that of the mixed cyclotron emission is 43 Vic. The apparent x/r ratio, from 0.3.

1-A-2 R.

DROPHILPHA MELANOGAstra

The development of dominant lethal mutations was investigated. Suggests to 400 and to 1200 r, and 3�e stages of spermatogenesis were induced. (354)

Alexander, M. L. RADIODEN SPECTROMATOGONAL CELLS OF THE Spermatogenesis rate, when calculated with spermatogonia with 900 r of x-rays for the sensitivity of the two types of mutations, account for the difference. The two types of mutations as obtained with male. (619)

Alexander and Stone 1955 -

Brookeley, A. P. THE EFFECT OF THE MEALWORM, TENERISSO MELANOGAstra.

In preliminary experiments, on the precise age of the larvae, no observable difference in effect occurred 6 h after formation. The time of pupation of larvae and also those that the lighter larvae are more sensitive

Brookeley, A. P. THE EFFECT OF THE MEALWORM, TENERISSO MELANOGAstra.

A genetically mixed culture hatched normally. After 200 days of development, region between 1000 r and 2500 r in length of the pupal stage.

853 Abereve, G. A., and Potezhina, N. A. RADIOSENSITIVITY OF DIFFERENT STAGES OF SPERMATOGENESIS IN PROSOPHILA MELANOSTORM. (in Russian) Proc. Acad. Sci. USSR, 1960, 120, 2. The development of different lethals in irradiated 24-h-old Prosopli melamostorm sperm and spermatids was investigated. Single exposure to 2400 r, 3 exposures to 800 r at 3.5-hour intervals, single exposure to 400 and to 1200 r, and 3 exposures to 400 r at 3-hour intervals were used. Radiosensitivity at various stages of spermatogenesis was evaluated. (N.S. 15, 10588, 1961)

854 Alexander, M. L. RADIOSENSITIVITY AT SPECIFIC AUTOSOMAL LOCI IN MATURE SPERM AND SPERMATOGENAL CELLS OF PROSOPHILA MELANOSTORM. Genetics 40 (1960) 1019-22. The mutation rate, when calculated with point mutations, was higher in mature sperm than the rate for spermatogonia with 900 r of x-radiation. The higher rate in sperm shows a difference in the mutational sensitivity of the two types of cells. Selection of chromosome breakage types from spermatogonia cannot account for the difference. The spermatogonial mutants show the same proportion of viable and lethal mutations as obtained with mature sperm with 900 r. The absence of chromosome aberrations remained characteristic of spermatogonial mutants. (auth.)

855 Broodway, A. P. THE EFFECTS OF X-RADIATION ON LARVAL AND PUPAL STAGES OF THE YELLOW MEALWORM, TENEBRIUS MOLLITOR, Linn. Biol. Bull. 109 (1955) 356. (Paper read by title only) In preliminary experiments, doses of 4000 to 4600 r were used on larvae of T. mollitor Linn. Since the precise age of the larvae was unknown, specimens were divided into two weight groups. There was no observable difference in effects between doses ranging from 2750 to 4000 r when given to pupae within 6 h after formation. The time required for pupation was increased. Irradiation thus tends to inhibit the pupation of larvae and also prevents the formation of normal adults. In determining LD50 values, it appears that the lighter larvae are more radioresistant than the heavier and presumably older larvae. Details are given.

856 Broodway, A. P. THE EFFECT OF X-RADIATION ON THE PUPAE OF THE YELLOW MEALWORM, TENEBRIUS MOLLITOR, Linn. (abst.) Biol. Bull. 111 (1956) 297-6. (Paper read by title at Marine Biological Laboratory) A genetically mixed culture of larvae was used. All pupae used as controls or given 500 r were hatched normally. After 2000 r, only 39% hatched. From 2500 r to 2000 r, all hatched abnormally. The region between 1000 r and 2500 r appeared to be quite critical. Some effect was also observed on the length of the pupal stage. Pupation of controls was 8.15 d; 500 r increased it to 9.0 d, 4500 r to 10.0 d,

I A 2 RADIOSENSITIVITY OF ONE OR MORE STAGES OF DEVELOPMENT

The effectiveness of fast neutrons, (Anoplus differentialis), on every egg in each grasshopper irradiated the total body with 350 r. Thus, the relative biological effectiveness of fast neutrons in the range of 2 to 20 mm within the ovarioles may well be lower than that reported for other species.

The effectiveness of fast neutrons, (Anoplus differentialis), on every egg in each grasshopper irradiated the total body with 350 r. Thus, the relative biological effectiveness of fast neutrons in the range of 2 to 20 mm within the ovarioles may well be lower than that reported for other species.
5000 to 20,000 r to 11 d. At 2500 r the emerging adult was unable to shed the pupal cuticle. The tanning process of the new cuticle was incomplete in all adults irradiated with 2000 r at the pupal stage. Blistering was also observed.


F1 males irradiated with 1000 r x-rays were mated with different classes of females 5, 6, 8 and 11 d after treatment. The incidence of dominant lethals, hyperplasias and translocations (structural changes) and recessive autosomal and sex-linked lethals (gene changes) were recorded for each day (tables and graphs).

Estimates of induced crossing-over in the h pr yg region, made in daily samples from the 2nd to the 10th day, were used to identify specific stages of germ cell development. In addition, the excess of animals showing a single recessive marker over those showing two markers was used to estimate the proportion of "mutations" or small deletions. The pattern of sensitivity was similar for recessive autosomal and sex-linked lethals and translocations, showing a rise from the 2nd day (t12pm) to the 5th (tpermis) followed by a fall on the 8th (tpermis or later spermatogonia). Deleted X's showed a unique sensitivity pattern with a peak on the 8th day. This was attributed to the high sensitivity of spermatocytes to intra-changes and in particular to deletions. (auth. summary)


Results are reported in an investigation of the relationship between chromosome number and radioresistance in the parasitic wasp, Habrobracon. In this species haploid males and diploid females occur normally. Data on the differential radiosensitivity of the cleavage stage of the embryo, larval stage, and pupal stage indicate that the differential radiosensitivity between haploids and diploids is dependent upon the stage of development of which the organisms were irradiated and cannot be correlated with gene number. No direct correlation was found between the radiosensitivity pattern and oxygen consumption, phosphatase activity, nucleic acid changes, and catalase activity. (NSA 8: 973, 1964)

Clark, A.M. THE RELATION OF GENOME NUMBER TO RADIOSENSITIVITY IN HABROBRACON. (abstr.) Radiation Res. 11 (1954) 491.

Haploids and diploids of the parasitic wasp, Habrobracon, were x-irradiated at different stages during their development. Their radiosensitivity was measured by counts of adults that emerged from cocoons. The data show that the differential radiosensitivity between haploids and diploids does not remain constant throughout the life cycle but varies with the stage of development. During the cleavage stages of the embryo, haploids are more radio-resistant than diploids. At later embryonic stages, haploids and diploids are equal in radiosensitivity. In the larval stages the differential radiosensitivity varies with age; among young larvae, diploids are only slightly more resistant than haploids, whereas among older larvae, diploids are markedly more resistant than comparable haploids. This increase in differential radiosensitivity becomes greater during the prepupal and pupal stages. It is concluded, therefore, that there exists no simple correlation between genome number and radiosensitivity throughout the life cycle of Habrobracon.

Clark, A. M. SENSITIVE PERIODS AND APPARENT FRACTIONATION EFFECTS IN IRADIATED DROSOPHILA. Amer. Nat. 89 (1955) 179-81.

Five successive matings, 72 h apart, of newly emerged Canton S males treated with 4 doses of 700 r delivered at 24 h intervals were compared to a group receiving 2800 r at 72 h of age. No significant overall differences were seen; the distribution of lethals and translocation was altered, however, so that the peak seen at the 2nd and 3rd brood was not masked in the fractionated group. Both translocations and lethals were significantly lower in the 4th and 5th broods of the fractionated series.


Haploids and diploids of the parasitic wasp Habrobracon were x-irradiated during known stages of embryonic and post-embryonic development, and compared with regard to their sensitivity to damage by x-rays. The ability to continue development and to emerge from cocoons as adults was used as the criterion of injury. The ratio of haploids to diploids radiosensitivity is different for different stages of development. During cleavage stages of embryonic development haploids and diploids are equal in sensitivity; during the post-

embryonic stages diploids are the more resistant. The site of injury from radiation was at the foreleg.

862 Clark, A. M. THE RELATION OF GENOME NUMBER TO RADIOSENSITIVITY IN HABROBRACON. Amer. Nat. 91 (1957) 111-9.

863 Habrobracon prepupe and pupae have been studied. Ecllosion ratios show that haploids have a lethal rate similar to that of diploids. Both male and female diploids and prepupe are more sensitive than the haploids, given the same total dose but lower intensity. Comparison of a series of haploids and diploids show that the difference in sensi-
tivity of haploids and diploids is a factor of about 10.


The study was aimed at establishing the effects of x-rays on different stages of pupal development of the parasitic wasp. The rate of hatchability of haploids and diploids was found to be 5% to 7%. The increase in the number of haploid pupae (7-5 d) was found to be due to radiation on somatic tissues.

(A report, ASGU-1444, Technical Notes, Genetics 26 (1952) 547)


Haploids and diploids were reared to determine what extent radiation would affect development. The development of the parasitic wasp was studied during cleavage, hatching, and development. The radiation dose was found to affect development and hatching of the wasps. The results of the study are that radiation affects the development of the wasp and hatching of the pupae.


The variation in the radiosensitivity of embryos at different ages is studied. The values are tabulated, and the effects of radiation on development are described.
embryonic stages dipoles are more resistant than haploids. The bearing of these data on determining the site of injury from radiation is discussed. (auth.)


Progress is reported in studies on the effects of oxygen on insects, a comparison of radiation damage and oxygen poisoning, and the effects of x-radiation on the life span in haploids and dipoles of Habroracon. (NSA 16: 1095, 1960)


Habroracon prepupae and pupae were exposed to x-radiation, and the lethal effects of the radiation were studied. Ectodermal ratios show that x-rays have a greater lethal effect upon haploid males than upon diploid females. Diploid males and diploid females are equally susceptible to the lethal effects of x-radiation. Prepupae are more sensitive than pupae. No significant difference in sensitivity was obtained for adults given the same total dose but at different intensities. The response, therefore, seems to be independent of intensity. Comparison of adults developing from irradiated prepupae and pupae shows that a greater number of haploid males show structural malformations than diploids irrespective of sex and that the haploids raise these malformations to a greater degree. Comparison of individuals unable to emerge from cocoons shows that the diploids are in general more advanced in their development than are the haploids. The data show that diploids are more resistant than haploids to the lethal action of x-rays, suggesting that the number of chromosome sets is a factor in determining the radiosensitivity of cells. (auth.)


The study was aimed at establishing whether there exists a constant difference in resistance during different stages of pupal development. Dipeptides were found to be more radiosensitive than haploids during all stages of pupal development. During the earlier pupal stages, diploids are about three times as resistant as comparable haploids while during the later pupal stages the differential radiosensitivity is not so great. Resistance increases with age. For haploid pupae, the increase in resistance is exponential for the period from 8 to 8 d. The increase in resistance for 5-d diploid pupae is identical with the haploid; the older diploid pupae (7-8 d) do not, however, increase as rapidly in resistance. The deleterious action of radiation on somatic tissues is interpreted to be due primarily to injury to the genetic mechanism. (auth.)

(A report, ASC-1444, Technical Information Service, AEC, 15 p., was published, also an abstract in Genetics 36 (1951) 547)


Haploid and diploid embryos of Habroracon were x-rayed at known stages of development in order to determine to what extent radiosensitivity can be correlated with genome number. When embryos are x-rayed during cleavage, haploids are more resistant than diploids; when embryos are x-rayed immediately after cleavage has been completed, haploids and diploids are equally radiosensitive. Embryos x-rayed during cleavage or early blastema are deleteriously affected during the egg stage or not at all. Older embryos when x-rayed may hatch, but show post-embryonic injury. Embryos that are x-rayed during cleavage and fail to hatch are arrested before blastulation. The nuclei are arrested at interphase and become enlarged up to four times the diameter of untreated nuclei. Since the differential radiosensitivity between haploids and diploids depends upon the stage of development at which they are irradiated, it is difficult to pose a single hypothesis that will account for these facts. (auth.)


The variation in the radio sensitivity of Locusta embryos was studied with various x-radiation exposures at embryonic ages from 1 to 6 d. The D50 was determined as a measurement of the sensitivity. These values are tabulated, and show that the resistance to irradiation increases rapidly with the age, varying
from an ED_{90} of 136 r on the 1st day to 6900 r on the 6th day. The high resistance of insects to radiation was shown to develop during the embryonic stage after organogenesis. (NSA 14: 3415, 1960)


Data are presented on Habrobracon juglandis (Ashmead), and a figure is given which shows the pattern of radiation-induced effects for most of the life-cycle, to delineate the divergence between sterilizing and lethal doses. (Doses of up to 10,000 r at 600 r/min were given, the age in hours ranging from 0 to 180.) The weakest link in an insect life-cycle was determined and related to the quantitative differences between the sterility and lethality doses when virgin females were irradiated at various developmental stages. The curve for increased radiosensitivity does not progress smoothly. Biological considerations are offered in explanation.


Evidence is presented to show that adult longevity of Habrobracon juglandis (Ashmead) is a sensitive criterion of radiation damage compared with other parameters when the wasps are x-rayed as 24-h-old embryos. The performance of adult females thus x-rayed as 24-h-old embryos is tabulated in terms of adult females emerged, and egg hatchability and longevity. On the basis of longevity, the wasps were damaged by a 500 r exposure, with a striking effect at a 1500 r dose.

* Fritz-Niggli 1952 - [1905]

869 Fritz-Niggli, H. MÖGLICHE URSCHEIN DER VERSCHIEBENEN STRAHLENEMPFEHLDICHKEIT DES ERB MATERIALS IN KERNZELEN UNTERSCHIEDLICHEN ALTERS (Possible causes of the differences in radiosensitivity of genetic material observed in germ cells of different ages). Naturwissenschaften 40 (1953) 567-64. (In German)

Much of the experimental data is derived from Drosophila melanogaster. Radiation-induced mutation rates depend on the age of the germ cells, and they may be raised or lowered by a variety of factors which are discussed. It may be supposed that the differences in sensitivity may, at least in part, be due to changes in intracellular oxygen content.

* Gray 1956 - [1311]

* Heidenhahn 1953 - [999]

870 Lacey, W.M., Quastler, H., Chase, H.B. REDUCTION IN FACET NUMBER IN BAR-EYED DROSOPHILA BY X-RAYS. Genetics 35 (1951) 489-99.

The paper deals with a quantitative well-controlled response to x-rays: reduction of eye facet number in Bar-eyed flies. Larvae of Bar-eyed Drosophila, kept at a temperature of 25°C, which were irradiated with x-rays of dosages varying from 118 to 1840 r, developed into adult flies whose compound eyes had a smaller number of facets than untreated controls. With a dosage of 220 r the effect of the x-rays was largely confined to a radiosensitive period extending from about 55 to 70 r of egg-larval life, with a maximum reduction occurring between 57 and 67 h. The radiosensitive period closely corresponds to similar sensitive periods for other environmental agents affecting facet number in Bar-eyed Drosophila. The reduction in facet number following application of x-rays during the sensitive stage was nearly proportional to the dosage applied. In males the reduction in facets per unit dose was always greater than in females. The biological effect of the x-rays and the nature of the mode of action of the Bar mutants are discussed.

* Lanning 1954 - [1400]

* Lanning 1952 - [1808]

* Lanning and Jonsen 1954 - [1210]

* Lanning and Jonsen 1956 - [1003]


872 Nihashi, S., Yamaguchu, M. ON THE EGGS AND SPERM OF DROSOPHILA. The lethal effects of x-rays on pupae, were studied. The L_{90} in fertilized eggs was found to be a change in radiosensitivity which indicate that cleavage accident, hatching rate of unfertilized eggs seems to be more sensitive.

873 Olenov, V.M., Galkovskaya, V. IONIZING RADIATION ON DROSOPHILA, a translation into English Insecta Entomological, 1959.

Olenov exposure of larvae cells of the imaginal discs, of the incomplete repair of the obtained repair to give the stage for which the repair has been given indication, for a given the deviations caused by it is the effect of ionizing radiations, working out a theory of the basis.

* Oster 1959 - [1047]


875 Ray, D.T. X-RAY SENSITIVITY OF DROSOPHILA. Female wasps were treated with x-rays and set with host pupae of the same sex. Eggs laid at successive intervals were used for different stages. Eggs laid were those of females as compared to controls. It was found that the eggs expected, there was a drastic effect in 6 h after treatments above 1000 r. Eggs laid in successive hours of the same day showed a high rate of meiotic metaphase to high meiotic stages. A more accurate investigation during the normal chamber technique, hitherto (Abstract of paper presented at Aug. 26 to 28, 1957)


Female Marmorina wasps were...


The lethal effects of x-rays on sperm and unfertilized eggs of mosquitoes, Aedes aegypti and Culex pipiens pallens, were studied. The x-ray dose was 100-1000 r and the dose rate was 90-115 r/min at 60 KV potential. LD40 in fertilized eggs was 500 r in Aedes aegypti and 150 r in Culex pipiens pallens. A marked discontinuous change in radiosensitivity was observed in fertilized eggs between 2-3 hr after oviposition which seems to indicate that cleavage accompanying mitosis or nuclear division might be occurring at that age. The hatching rate of unfertilized eggs and sperm showed no marked decrease with doses less than 500 r. Sperm seemed to be more sensitive to irradiation in vivo than unfertilized eggs. (BA 28: 2996, 1954)


Roentgen exposure of larvae and pupae of Drosophila melanogaster causes the destruction of part of the cells of the imaginal disks, the rudiments of definite organs of the insect. X-ray mutations are the result of the incomplete repair of this injury. Their frequency depends upon the time of repair. The data obtained permit one to give a new interpretation of the concept of the selective period in ontogenesis. The stage for which the repair process caused by the inflicted injury coincides with sensitive period for a given indication, for a given external influence. The destruction of part of the undifferentiated cells and the deviations caused by it in the further course of ontogenesis are obviously a general characterization of the effect of ionizing radiation on the developing organism. One should have this picture in mind when working out a theory of the biological action of ionizing radiation. (auth.)

Oeter 1959 - [1047]


Female wasps were treated with x-rays of different doses (1000 r = 1000 r = 2500 r = 5000 r), and set with host pupae of the fly Sarcophaga bullata. They were transferred to new host pupae at frequent intervals. Eggs laid at successive times after treatment were treated at different meiotic (and even pre-meiotic) stages. Eggs laid within 6 hr after x-raying had been rayed during the first meiotic metaphase. Since the females were undamaged they produced all haploid males parthenogenetically. Offspring per females as compared to controls furnished a rough estimate of the presence of lethals. Results seem to indicate that while the fecundity of treated females decreased with the increase of x-ray treatment, as expected, there was a drastic reduction in the number of offspring secured from eggs laid during the first 6 hr after treatments above 1500 r. Reduction in the number of offspring as treatment increased from eggs laid in successive hours was not nearly as drastic. This indicates a higher sensitivity of the first meiotic metaphase to high doses of radiation with sensitivity decreasing in the earlier meiotic and premeiotic stages. A more accurate estimate is being made by egg counting. This was made possible by investigations during the summer of 1955, demonstrating rearing offspring from counted eggs (damp chamber technique) hitherto not possible.

(AbSTRACT OF paper presented at the 1957 meetings of the Genetics Society of America, Stanford, California, Aug. 26 to 28, 1957)


Female Mormoniella wasps were irradiated with varied dosages (500 r = 1000 r = 1500 r = 2000 r = 2500 r).
They were placed with host pupae of the fly Sarcophaga bullata and transferred to new host pupae at frequent intervals. Eggs (laid at successive times after irradiation) had been irradiated at different melanotic stages. Eggs laid within 6 h after irradiation had been x-rayed during the first melanotic stage. Egg counts were made using the damp chamber technique. Because of the parasitic nature of Mormonita, an accurate count of eggs could only be made by removing them from their host. The counted eggs were placed in another host for further development. The new host pupae were first stung by sterile female wasps. A small aperture was made in the pupae and the eggs inserted within. The pupae were then placed in open mouth vials and suspended by metal racks over a saturated solution of NaCl in large covered jars, to ensure the correct humidity and discourage mold. The eggs were observed for hatching and development without being disturbed. Results indicate that while the number of eggs hatching decreased as expected with increase in x-ray treatment, the number of offspring from eggs laid during the first 6 h decreased drastically. Only 0.6% of these eggs from females given 1000 r developed as against 30% of eggs laid after 24 h. No eggs developed from wasps given doses above 1500 r in this group. Reduction in the number of offspring from eggs laid in successive hours was not nearly as drastic. This seems to indicate a higher sensitivity of the first melanotic stage to irradiation, with the sensitivity decreasing in the earlier melanotic and penmelanotic stages.


An attempt is made to find the time of appearance of sperm irradiated in melanotis by a direct method, and at the same time to correlate it with the sensitivity pattern. It could be shown that the treated melanotic cells become available for insemination during the 7th day after irradiation and onwards. The peak of sensitivity would appear to correspond to cells treated during melanophasic I or before anaphase I is completed.


The radiosensitivity of the cricket embryo at various stages of development was studied. Embryos were exposed at ages 2, 24, 48 and 72 h and 4, 5, 6, 7, 8 and 9 d to 550 and 350 r. The variation in the percentage of hatching and the variation in the length of embryogenesis were used as the criteria to evaluate the radiation effects. The two radiation doses had essentially the same effect. The results showed that the radiosensitive stages are characterized by zero (2 h) or slow (48 h) mitotic activity. In the radiosensitive stages corresponding to periods of intense mitotic activity, the radiation doses used appeared to either completely stop the embryonic development or to have no effect at all. (Extr. 15: 5549, 1961)

Tosieve, N. M., Asturias, F. L. ПОВЫШЕНИЕ УСТОЙЧИВОСТИ ПОЛУЧАЕМЫХ ЖИЗНЕННОГО ПЛЮЩА (Hymenoptera, Mordi, L. К ЕВРОПЕЙСКИМ ПОДВЕРЖЕНЫМ РАДИАЦИИ. Биологические Записки 2. 2 (1958) 197-203.


The radio-resistance of silk worm embryos in the stages from dispaus to middle spring development increases with the degree of polyploidy, other things being equal. There is a marked in resistance between diploid and triploid, and a lesser one between triploid and tetraploid. The data support the idea as to the essence of the biological effects of ionizing radiations. They show that the main cause of such effects as radiation damage to embryos of multicellular organisms are genotype changes in the cell nucleus. (aut.)

Ulrich, H. RÖNTGENSTRahlUNG VON DROSOPHILAEINEN (Partial x-irradiation of Drosophila eggs). Naturwissenschaften 36, 9 (1951) 121. (In German)

Drosophila eggs 1 h after being laid were irradiated with 200 r of x-rays. By using a screen with a slitlike window it was possible to investigate the influence of irradiation on S successive zones each 0.1 mm wide. A maximal sensitivity, expressed in percentages of non-hatchability, could be established for the second region of the anterior part of the egg. (BM 14, 7; 92, 1955)

Ulrich, H. ERGEBNISSE EINER VON PARTIellen X-StrahlUNG EINSCHLIESSLICH DROSOPHILEINEN (Partial x-irradiation of Drosophila eggs). Naturwissenschaften 36, 9 (1951) 121. (In German)

On exposing different portions of the egg, dead eggs demonstrate a not first portion of the egg, effect of the egg some similar but somewhat shifted of the egg, with a maximum of 10% of the egg is affected. Ulrich, H. SINGLE EFFECT 27 (1958) 117-8.

Ulrich, H. Die Bedeutung DER RÖNTGENSTRahlUNG DER DROSOPHILEINEN (Drosophila eggs). Naturwissenschaften 36, 9 (1951) 121. (In German)

Does-effect curves obtained and used in quantitative investigations in x-rays. Irradiation with 1000 r total irradiation showed that the cytogenetic damage can be seen.

Ulrich, H. Ein Vergleich DER DROSOPHILEINEN (Drosophila eggs). Beitr. Zbl. Z. Z. 70. 9 (1951) 121. (In German)

10-20 min-old eggs from male division, after first half. The radiation effects, showing separate irradiation of the animals with lethality, certainly exceeds 100% (in Drosophila) (A note also appeared in Drosophila action of x-rays on normal embryonic development.)

Ulrich, H. Die Strahlenwirkungen der Indirekten mutagenen effects of 180-82.

10-20 min-old Drosophila embryos dependence of the nucleus a nuclei appear to result from individual still during early death of the larvae, i.e., later in surviving flies. When destruc- tive lethal mutations are made whether this indirect effect is irradiation.

Van den Bruel, W. E., Bolla, V. SITOPHILUS GRANARIUS L. (Repr. 16 agg. Gembloux)

A dose of 20 000 rad did not 2 d of deposition prevented a large number of adults that developed. Irradiation of the 1st and 2nd fertility of the adults, but also the 2nd and 3rd instar of S. j. Oxyac. No adults were pre-

On exposing different portions of 1-2 h-old Drosophila eggs to an x-ray dose of 200 r, the percentage of dead eggs demonstrates a non-uniform radiosensitivity. Maximum sensitivity occurs in the anterior second fifth portion of the egg, effectively at the cleavage centre, beyond which the sensitivity decreases. A similar but somewhat shifted curve for the distribution of radiosensitivity is obtained for the posterior portion of the egg, with a maximum in the third or middle fifth of the egg.


Ulrich, H. DIE BEDEUTUNG VON KERN UND PLASMA BEI DER ABTÖTUNG DES DROSOPHILA-EIES DURCH RÖNTGENSTRAHLEN (The significance of nucleus and cytoplasm in the killing by x-rays of the Drosophila egg). Naturwissenschaften 42 (1955) 468. (In German)

Dose-effect curves obtained from 10-20 minute-old Drosophila eggs prior to cleavage can be used for a quantitative investigation into the significance of nucleus and cytoplasm in the process of killing the egg by irradiation. Irradiation was applied either to the anterior or the posterior half of the egg. Anterior and total irradiation showed that damage to the nucleus caused death, whereas posterior irradiation indicated that cytoplasmic damage can also be responsible for death. The possible mechanism of killing is discussed.


10-20 min-old eggs from mated wild-type females were irradiated in late telophase of the second mitotic division, during first and second cleavage. The nucleus of the unfertilized egg lies in the anterior half. The radiation effects, both qualitatively and quantitatively, were found to be quite different for separate irradiation of the anterior and posterior halves. Results for anterior irradiation correspond quantitatively with lethality records for whole-egg irradiation. The sensitivity ratio of nucleus to cytoplasm certainly exceeds 182:1 (in terms of equivalent lethality at the 50% lethality dose). (A note also appeared in Drosophila Inform. Serv. 29 (1958) 170-1, under "Comparative studies on the lethal action of x-rays on nucleus and cytoplasm of Drosophila eggs before cleavage")


10-20 min-old Drosophila eggs were used to further study the differences in radiosensitivity and dose-dependence of the nucleus and plasma, and to investigate radiation death. Death from irradiation of the nucleus appears to result from a dominant lethal mutation. Such irradiation leads to an early death of the individual still during early embryonic development whereas irradiation of the plasma leads mostly to death of the larvae, i.e. later death. Physiological damage (segmentation disturbances) frequently occur in surviving flies. When death resulted from damage to the plasma (irradiation of posterior half), successive lethal mutations were also found in the screened-off nucleus. Further work is required to determine whether this indirect effect on the nucleus is due to scattered radiation or chemical action resulting from irradiation.


A dose of 20,000 rad did not destroy all pupae and adults in wheat grain. A dose of 1000 rad applied within 2 d of deposition prevented almost all the eggs of S. oderne from giving rise to adults but reduced the number of adults that developed from those of S. granaria and their larval progeny by 40 and 27% respectively. Irradiation of the 1st and 2nd instar larvae of both species at 1000 rad had little effect on the number and fertility of the adults, but at 2500 rad a sterilizing effect on the adults was noticed, especially when applied to 2nd and 3rd instars of S. oderne and 3rd instar pupae and adults and to a lesser extent 2nd instar S. grana.
In both species 5000 rad prevented the development of adults when applied to the 3rd instar or to younger stages and greatly reduced the numbers that developed when applied to later stages; virtually all the adults produced were sterile.


A 2-Mev Van de Graaff electron accelerator was used for irradiation. The technique for irradiating individual cockroaches under controlled conditions is described. The exposure dose was 10,000 rads. The sensitivity of the adult cockroach, Periplaneta americana, to radiation increases with age, as measured by the change in ratio between the T50 (time in days when 50% mortality occurs) of irradiated and unirradiated insects of different ages. Irradiated females survive longer than males. Survival is affected by the state of nutrition. Death due primarily to irradiation with 10,000 rads has been demonstrated to occur independently of starvation effects. Post- as well as preirradiation starvation reduced resistance to radiation injury. Free-feeding after irradiation increases the longevity of the male but does not affect the survival of the female. Irradiated and starved insects of both sexes die sooner than starved controls. They lose a smaller fraction of their weight than the controls but at a greater rate. The effect of a divided dose at any given tine is less than that of the single total dose. The results are discussed with special reference to the nutritional state of the insects and to the change of radiosensitivity with age.

I-A-3 RADIOSENSITIVITY OF DIFFERENT SPECIES OR STRAINS

* Baker et al. 1953 - [1238]
* Baker et al. 1954 - [1241]
* Baker et al. 1955 - [1245]
* Baker and Edington 1955 - [1266]
* Borstel and Paradies 1956 - [979]
* Borstel and Paradies 1957 - [980]
* Borstel and Rekemeyer 1959 - [987]


The LD50 of gamma radiation from Cs against the body louse (Pediculus humanus humanus L.), house-fly (Musca domestica L.), American cockroach (Periplaneta americana L.), German cockroach (Blattella germanica L.), firebrat (Thermobia domestica (Pack.)), bed bug (Cimex lectularius L.), and Pharaoh ant (Mono molorum pharaonis L.) ranged from 130 r for half-day old fly eggs to 190,000 r for body louse nymphs and Pharaoh ant queen. Doses required to cause 100% mortality ranged from 600 r to 250,000 r. Among the species tested, the LD50 varied inversely with the size of the insect. Reproduction in body louse was inhibited at dosages of 75,000 r or higher. DDT-resistant body lice were as susceptible to gamma rays as non-DDT-resistant lice. (auth.)

* Cornwell and Burson 1958 - [1904]


For abstract only, see 891.

THE LONGEVITY OF THE COCK-ROACH FOOD INTAKE.

The technique for irradiating exposure dose was 10,000 rads. Action increases with age, as 99% mortality occurs of irradiated longer than males. Survival is 10,000 rads has been demon-stration starvation reduced the longevity of the male but does both sexes die sooner than starved but at a greater rate. The effect dose. The results are discussed with scale of radiosensitivity with age.


A comparison was made of the susceptibility to γ-radiation of adults of 5 laboratory strains and 30 wild strains of Calandra granaria L. with that of the Pest Infestation Lab., used as a standard. It was concluded that the dose level of 15,000 rep evaluated for the sterilization of large populations of the standard strain of C. granaria might safely be recommended for the commercial disinfestation of naturally occurring populations.


The paper forms a contribution to present knowledge of the entomology of radiation treatment of grain. An examination is made of the effects of γ-radiation on the two principal grain pests, when these are reared and retained under near optimum conditions for the species. The effects of radiation on the complete life-history of a laboratory strain (D Pest Infestation Laboratory, D.S.I.R.) of the grain weevil, C. granaria, were examined at 24-hourly intervals during the life-history. Each stage of development was subjected to 17 doses ranging from 250 - 25,000 rep. Three criteria were used to determine radiation susceptibility: (1) emergence of immature stages as adults from grain, (2) survival after emergence and (3) the production of adult progeny. Similar observations on all stages of the rice weevil, C. oryzae, allow a comparison of susceptibility in the two species. Additional studies with C. granaria include: (1) radiation susceptibility of the sexes and (2) periodicity in fertility at sub-sterilizing doses. Doses evaluated for commercial disinfestation are tested against massive populations and under a limited range of commercial storage conditions. The relative merits of fumigation treatment and radiation disinfestation are compared.

(This paper was published in full as AERE R. 3065, Atomic Energy Research Establishment, Harwell, Berks, England, 1959, 29p.)

* Fluke 1957 - [1184]
* Gray 1956 - [1311]
* Hassett 1957 - [1283]

892 Ives, P. T., Cooklin, F. M., Burwell, L. R. RADIATION EFFECTS ON DIFFERENT STRAINS OF DROSOPHILA MELANOGASTER (abstr.) Genetics 44 (1960) 517.

Tests were carried out on male mutational, and male and female longevity responses to γ-radiation using various strains of D. melanogaster. Both mutational and longevity responses to radiation appear to be subject to genetic modification in phenotypically normal Drosophila.

* Kaufmann et al. 1955 - [916]
* Klaro 1953 - [954]
* Lee 1956 - [1019]
* Lee 1958 - [1020]
* Nishiwaki et al. 1953 - [872]


Раздел I. Радиорезистентность насекомых, а) Изменение дозы летального действия радио-

Part I. Radiosensitivity of insects.

a) Variation of lethal dose from ionizing radiations with age.

b) Dependence of radiosensitivity on the type and quality of the radiation.


d) Comparative radiosensitivity during anabolism, catabolism, division of cells and during differentiation.

Part II. Problems in the control of insect pests by ionizing.

a) Ionizing radiation for controlling insect pests infesting food stuffs.

b) Ionizing radiations for controlling Caltrops.

The action of ionizing radiation has been studied on a number of insect pests: Calandra (Rhopalophila) granarum, C. oryzae, Tribolium confusum, Tenebrio molitor, Oryzaephilus surinamensis, Tribolium dominica, Lasioderma serricorne, Acrophosella obsoleta and others. All experiments show the similarity in the effect of different kinds of radiation and the inexpediety of using high doses (~ 10,000 r or even higher), as with 10,000 r, 100% of insects are only killed 7 d after irradiation. Such doses are uneconomical and result in undesirable changes in the crops. Instead, doses are proposed for causing sterilization and stopping reproduction or resulting in a certain accelerated mortality in irradiated individuals.

Ray and Whiting 1954 - [106]


(See later article in Ecology 46 (1965) 972-9 for fuller account)


A preliminary study. The life history of Caloclyphus mycophagus (prey) is presented in detail (life-cycle 4-9 d). Pseurotopus marginatus (predator) has a life-cycle of 20-48 d. A Co-60-radiation chamber was used. The doses delivered ranging from 250 to 3750 r at 19 t/ra. The predator male is rendered permanently sterile by doses that produce temporary sterility in the prey male. Data on the effects of irradiation on egg hatchability and on the viability of eggs from irradiated virgin adults are presented. P. marginatus eggs are insensitive to doses producing 50% mortality in C. mycophagus eggs of comparable age (LR0 for Caloclyphus eggs = 2300 ± 70 r)
Схема, Б. И., Фритц-Ниггли, Г. Д. СТРАХЛАММЕНЛЕНДИЧЕСТВО ФРОЙШЕМЕЙСТРЕСОВЫХ СТАДИИ ДОРОФИЯ ФИЛУСТУВАНТ ИМ ВЕРИГЕ СТРУДОФИЯ МЕЛАНОСТАТОЙ МЕЙНГЕ (Сравнение радиочувствительности ранних вегетативных стадий Дорофии Filusvant и Dorohipia melangaster Meigen). Strafflichen Therapie 104 (1957) 328-37. (in German)

Experiments were carried out to test whether number of chromosomes affected radiosensitivity. No increase in resistance was found with higher chromosome number. It is assumed that lethal effects are due more to biochemical changes than to chromosome damage.


1. Генетическая радиочувствительность мейнгее, определенная по частоте возникновения доминантных летальных гибели, одинакова у всех мейнгей и мейнгов, в оценке их в пять - десять раз.

2. Частота возникновения доминантных гибели у мейнге и мейнгов пропорциональна оценке радиоактивности промежуточных видов.


The genetic radiosensitivity of mouse, determined from the rate of formation of dominant lethals is, on an average, 5-10 times higher than for D. melangaster. The dominant-lethal mutation rates in mouse and Dorohipia are directly proportional to the overall chromosome size of the species.

(See also report received from Moscow, USSR, by the UN Scientific Committee on the Effects of Atomic Radiation, A/AC. 82/L.415, 1960, 31 p.)

Стреммас, Ф. X-RAY INDUCED LETHAL MUTATIONS IN SEVERAL STRAINS OF DOROFHIA MELANOSTATOSURUS. Hereditas 97 (1951) 39-59.

Males from 10 strains of D. melangaster were tested in regard to their sensitivity to the induction of dominant lethal mutations by 2300 r x-rays. Genetic differences in the sensitivity to induction of dominant lethal mutations by x-rays were found to exist between unrelated strains. (NAA 6: 770, 1952)

Стреммас, Ф. STOCK DIFFERENCES IN X-RAY MUTATIONAL SENSITIVITY PATTERN OF DOROFHIA MELANOSTATOSURUS. Hereditas 45, 2-3 (1959) 221-9.

These may be ascribed to differences in metabolic and maturation rates in the two stocks tested (Bio-Ambert and Oslo).

ТУСКОФИГУС МЕЙНГЕ. 1874

ON UPON CERTAIN DEVELOP-

ATOR AND PREY, INCLUDING STAGES. Ecology 46 (1965)

presented in detail (life-cycle
A Co^{60}-radiation chamber
predator male is rendered
male. Data on the effects of
Virgin adults are presented,
tuscouphus eggs of comparable

4 опытов о помощи метода экспериментального андрогенеза изучался относительный эффект первичных радиационных повреждений яйца и цитоплазы желточных желёз тетрапода (Hominytis more). Патологоанатомический анализ (СССР) 2 (1960) 573-80.

В 4 экспериментах с помощью метода экспериментального андрогенеза изучался относительный эффект первичных радиационных повреждений яйца и цитоплазмы желточных желёз тетрапода (Hominytis more). Патологоанатомический анализ (СССР) 2 (1960) 573-80.

In 4 experiments with the help of experimental androgenesis the effect of primary radiation-induced damage to egg and cytoplasmic yolk glands of reptiles was investigated. A Co^{60}-radiation chamber was used, and the male predator was rendered sterile. Data on the effects of a virgin adult were presented, tuscouphus eggs of comparable

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Survey

I - A - 4 RADIOSENSITIVITY AT THE CELLULAR LEVEL

Comprehensive review of the action of high-energy as compared with ultraviolet radiations, in terms of mitotic, morphological and cell viability effects, and their possible interpretation. Amongst the examples cited is work on grasshopper (Chorthippus) and Drosophilae. The extensive literature (p. 817-24) goes back to the beginning of the century.

A study on Bombyx mori, L.


A study on Bombyx mori.
Astrachan, B. L. INTERPRETING THE DIFFERENCES IN RADIATION DAMAGE TO THE NUCLEUS AND CYTOPLASM, IN CONNECTION WITH THEIR RESPECTIVE FUNCTIONS AND THE GENETIC THEORY OF RADIATION SICKNESS. Thesey dokladoi v yzyu uprulyaya na Simposium "Pervichnye mehanizmy biologicheskoi deistviya ioniz. izhuchenii", 30 May - 1 June 1960, s.7-9. Izd. MOP, Moskva (1960). (In Russian)

Work on Bombus mori is described.


Experiments were made on the mutagenic effect on paternal chromosomes of x-rayed egg cytoplasm in Drosophila melanogaster. The results indicate that if fertilization takes place shortly after irradiation such an effect may be produced. Further experiments are, however, desirable. (auth. summary)


Alpha-radiation was used to kill newly laid Harroboacon eggs by inactivation of the cytoplasm. Cytoplasmic inactivation is histologically and morphologically distinct from nuclear inactivation. The egg nucleus is inactivated by one a-particle, the 50% lethal dose is approximately 16 X 10^6 a-particles per egg when the cytoplasm is irradiated. Death occurs late in development when the cytoplasm is a-irradiated, and in most respects the morphology of the dead embryos resembles that from ultraviolet irradiation of the cytoplasm. (auth. summary)


Prolonged treatment of neuroblasts of Chromatophaga viridifasciata (DeGeer) with low intensity y-rays reduced mitotic activity much less than a comparable dose at high intensity. Details of the source, calibration, treatment, and a summary of data and biometrical analysis for dose rates of 3.4 and 0.80 r/h are given. The results demonstrate that radiation can retard but not stimulate the mitotic progress of cells. It appears that any increase in the number of cells in a given stage of mitosis soon after treatment can be interpreted to result from either retardation of mitotic progress within that stage resulting in an accumulation of cells or in entry into that stage, in a brief period of time, of an abnormally large number of cells that accumulate in a preceding stage as a result of mitotic retardation.

* Gaulden and Nix 1950 - [1385]

* Gaulden et al. 1953 - [1386]


Neuroblasts of the Chromatophaga viridifasciata embryo were studied in hanging-drop cultures. Frequency of mid-mitotic neuroblasts was found to increase as the quantity of yolk in the culture was increased up to a quantity equivalent to 1/4 that in an egg. The influence of yolk on mitosis in the untreated neuroblast is

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interpreted as indicating that, in this cell at least, the first half of prophase does not operate solely on energy stored within the cell but is dependent on an outside source of energy for continuation of mitosis. In x-rayed embryos it was found that the duration of the radiation-induced mitotic inhibition is shorter and the beginning and completion of recovery is faster in the neuroblasts of embryos cultured in yolk than in those of embryos cultured without yolk. The pronounced positive effect of yolk on neuroblasts from radiation damage demonstrates that, in this cell, some extracellular substance or substances can greatly enhance repair of mitotic damage. (BA 30: 1384c, 1956)

Gauden, 1956. "217"

Gauden, M.E. EFFECTS OF LOW-LEVEL RADIATION (1 to 3 r) ON MITOTIC RATE OF GRASSHopper NEUROBLASTS. ORNL-2927, Oak Ridge National Lab., Tenn. (Part of Semiannual Progress Report for period ending 15 Feb. 1957 of the Biology Division).

It would appear that low doses of radiation affect mitotic rate in the grasshopper (Chorthippus viridifasciatus) neuroblasts not by inhibiting DNA synthesis but by altering in some unknown way the physical structure of the chromosome. No influence of oxygen on mitotic effects of low doses of x-rays has yet been demonstrated. It should be noted that although the neuroblasts are extremely sensitive to the effects of radiation in producing temporary mitotic inhibition, they are fairly "resistant" to its effects in producing permanent inhibition.


Cytological and cytochemical studies were made on embryonic nuclei of the grasshopper, Chorthippus viridifasciatus, after x-ray doses of 4000, 10,000 and 15,000 r. The changes were measured photometrically by using (1) the Feulgen reaction to determine relative changes in the deoxyribonucleic acid (DNA) deoxyribonucleic acid, and (2) the methyl green stain to indicate the degree of polymerization of the nucleic acid. X-radiation caused swelling of the nuclei. When correction was made for this, the Feulgen-stained nuclei showed no significant loss of DNA after irradiation, but the nuclei stained with methyl green disclosed loss of stainability. This indicates that x-rays do not destroy DNA but rather induce depolymerization of the nucleic acid, hence, estimates of DNA in tissues stained with Feulgen or methyl green are not reliable. (CA 46: 9634c, 1952)


In order to study the effects of radiation on larvae of D. melanogaster, various imaginal discs and organs of 2nd instar larvae were cultured in a synthetic medium together with cephalic complex as a source of the metamorphic hormone. Irradiated discs or organs were used for culture in one series, and irradiated cephalic complex were used in the other. From the differences in results obtained in the two series, it was concluded that the decrease in % ecysis was caused by a functional disturbance of the cephalic complex induced by radiation. It was shown that brain, wing disc, and the testis were more radiosensitive than the eye disc, the leg disc, the salivary gland, and the fat body. (auth.)


In the present experiment, from the degree of incorporation of radioactively thymine-C14 into single cells isolated from irradiated larvae, differences in radiosensitivity of their constituent cells were found corresponding to the previous results. The ratio of PM incorporation into the whole tissue compared to DNA was highest in the cephalic complex, which may indicate an increased metabolic activity of the cytoplasm. The primary sites of the radiation attack were the large and small cells of the ring gland, which is a part of the cephalic complex. These are assumed to be the most active cells for the secretion of the metamorphic hormone in Drosophila larvae. (auth.)


Interference with DNA synthesis is known to be one of the most general and important biological effects of radiation. The effect of irradiation on DNA metabolism in some mammalian tissues is discussed, and also the radiosensitivity of DNA metabolism. Radiation-induced changes in cell populations, and the results of changes in cell populations are described. Mention is made of mitotic delay in grasshopper neuroblasts caused by radiation. The significance of the findings is considered. In the discussion, Hollaender cited work by Gaulden on the grasshopper neuroblast, where radiation effects were counteracted by placing the neuroblasts in a hypertonic solution immediately after irradiation. Experimental details were described. Reference was further made to work by Harrington and Koa who had found swelling of the cell immediately after a certain minimum dose, suggesting a radiation-induced change in osmotic-pressure relationships in the cells.


Cytochemical methods were used to study the alterations effected by ionizing radiations in nucleoproteins of dividing cells. In the studies on grasshopper embryos (Melanoplus femur-rubrum, Trimerotropis maritima), and *Chortophaga viridissiaca*, comparisons were made between irradiated and non-irradiated (shielded) halves of the embryos, as well as between individuals removed from the same egg pod. The capacity of salivary-gland cells of larvae of *Drosophila melanogaster* to swell when treated with an aqueous solution of trepsin, with water, with a solution of electrolytes, and finally with water was reduced when the larvae had been exposed to ionizing radiation, demonstrating that structural nucleoproteins were partially degraded by the x-rays.


A cytological study was made of ovaries from 12-d-old flies, irradiated with 4000 r (about 100 R/s) of y-rays from a Co60 source shortly after emergence. Irradiated and control ovaries amounted to about 50%. Many severely damaged oocytes underwent pyometic degeneration. The number of developing eggs was reduced to 8% of the control value. Treated ovaries showed abnormalities which are ascribed to radiation-induced disturbances of cell growth, division, migration and differentiation. The abnormalities are described.

(An abstract was published in *Anat. Rec.* 126; (1957) 576, abstr. 14.)

Limbough and Gaulden 1957 = [1259].


The effect of x-irradiation on the esterase and protease activities of chymotrypsin and chymotrypsinogen has been studied. The degree of inactivation has been compared to results obtained in a study of the ability of the irradiated samples to react with a specific inhibitor (DFP). The data suggest that radiation damage to enzyme molecules may result in impairment of catalytic efficiency without complete destruction of biological activity. These results are discussed. (auth. summary)


Both spermatids and spermatozoa have condensed chromosomes, found to be the most radiosensitive state in many organisms. The differential radiosensitivity found in *Drosophila melanogaster* spermatids and spermatozoa was investigated by x-irradiation in nitrogen, air and oxygen of spermidids, and of mature spermatozoa in 3-4-d-old males and in 24-d-old females with 1200 r and 2800 r (both single and fractionated dose). In spermatids, O2 produced no appreciable effect over air but N2 lowered radiation effects (autosomal transplantations) considerably. In spermatozoa, in the male or in the female, N2 and O2 modified the dose response below and above the air response about equally. The high sensitivity of the spermatids may be due to more intra- and/or intercellular; O2 being normally present (or available) in these cells. (from abstr.)
St. Amand, W. X-RAY-INDUCED NEUROBLAST AND THE EMBRYO.

The response of the ascites tumor forms there is an initial decrease in cell number, followed by a period of increase. The increase of cells is due to the formation of new tumor cells from the damaged ones. The cell numbers then decrease again, indicating that some of the new cells are not able to grow. This process of growth and decline is repeated several times before the tumor finally regresses. The study suggests that the damage caused by radiation is not permanent and that the cells have the ability to recover and continue growing.

St. Amand, W. MITOTIC NEUROBLASTS BY X-IRRADIATION.

Using living, unstained cells and cells fixed with glutaraldehyde, the authors observed that x-irradiation causes cell death in mitotic neuroblasts. The cells show characteristic changes, such as the formation of microtubules, which are not seen in control cells. These changes are indicative of the damage caused by radiation and suggest that the cells are unable to proceed through mitosis.


D. viridis males, 15 to 30 h postnatales, were used in this study to investigate the effects of different gas environments on cell proliferation. The study found that the gas environment had a significant effect on cell proliferation, with oxygen being the most effective gas for promoting cell division. However, the effect of different gas environments on cell proliferation is not fully understood and further research is needed.

Tahmazian, T.N., Adamek, F. KYNOSES IN THE LIVING CELL.

Melanopus differentialis embryos undergo changes in behavior following exposure to various environmental stimuli. These changes include alterations in activity levels, feeding behavior, and locomotion. The study suggests that exposure to different environmental stimuli can induce changes in the behavior of embryos, which may have implications for understanding the role of environmental factors in the development of behavior in the wild.
sensitivities. Middle telophase (most sensitive) is about twice as sensitive as very late prophase (least sensitive).


The response of the ascites tumor cell to x-rays is identical to that of the grasshopper neuroblast. In both forms there is an initial decrease followed by a compensatory rise in mitotic activity. Maxima of chromosomal effects correspond to maxima of mitotic inhibition. The neuroblast study, in which cells in known stages of mitosis were irradiated, showed that the temporal correspondence of mitotic inhibition and chromosome breakage is not a causal relation. The relative sensitivities of mitotic stages in populations of dividing cells cannot be determined by the use of devices such as "time after irradiation" or "hours before metaphase" because of the mixture in terms of stage treated represented by cells in metaphase or anaphase at any given time after treatment. The admixture of cells is a function of (1) different degrees of inhibition exhibited by cells irradiated in any given stage, (2) stage differences in inhibition sensitivity, (3) reversion of cells irradiated in some prophase stages, and (4) differences in inhibition in cells which show chromosomal damage as compared with those which have suffered no apparent chromosomal damage. (Almost entire abstract)

926 St. Amant, W. MITOTIC INHIBITION AND CHROMOSOME BREAKAGE INDUCED IN GRASSHOPPER NEUROBLASTS BY X-RADIATION AT KNOWN MITOTIC STAGES. Radiation Res. 5 (1956) 65-78.

Using living, undamaged cells, the relative sensitivity of each stage of mitosis in the neuroblasts of the grasshopper Chorthippus parallelus (DeGeer) was determined with respect to mitotic inhibition and chromosome breakage induced by 20 kV x-rays. The stage of mitosis at the time of irradiation is known for all cells from direct observation. The sensitivity curve of chromosome breakage shows 2 maxima (middle prophase and middle telophase) and 2 minima (interphase and very late prophase). The sensitivity curve relating mitotic stage to chromosome breakage obtained is strikingly similar to that relating mitotic stage to viability obtained for other kinds of cells. The sensitivity curves for viability and chromosome breakage differ in mitosis and meioesis.


D. viridis males, 15 to 30 h after eclosion, were irradiated with 2000 r in 1 minute at 0-5°C in different gas environments. The number of dominant lethals and translocations induced in cells which were in the different stages of spermatogenesis were scored using sequential multiple matings over a three-week test period. The stages from meiosis through spermogenesis were much more susceptible to x-rays than spermatogonia or mature sperm. The cycle of damage for dominant lethals is similar to that for translocations but does not coincide with it completely. Papae were irradiated in air 1-3 d after pupation, the period during which larval structures including protein systems are being broken down. The rate of chromosomal abnormality produced is very high for the cells past spermatogonia. Complex translocations which involve 3 or more chromosomes occur much more frequently than in tests of mature sperm and rejoining of broken ends is not at random. Several enzyme systems are involved in a reduction of radiation damage or in the attachment of broken chromosomes. (BA 30; 15612, 1956)


Melanogaster differential embryos were used. The effect of 20 kV x-rays can be kept latent for 8 months by maintaining the eggs at sub-metabolic temperatures. When the eggs are irradiated and immediately placed at 0°C, and are thus maintained for 6 months no immediate morphological or physiological changes are observed upon returning them to 25°C. However, pyknosis occurs by 8 d at 25°C, depending on the irradiation and on the metabolic activity of the cell. Various changes in the cell are discussed. (This work was also published on p. 54 in ANL-4488, Argonne National Lab., 1950, 149 p., and as abst. 154 in Anat. Record 110: 72-3, 1950)
Prior to induction, cells in the grasshopper embryo are very susceptible to x-irradiation. A cell that has responded to the evocator, although it is undifferentiated morphologically but differentiated physiologically, is not easily affected by x-irradiation. Before induction, the ability of cells to differentiate into tissue can be inhibited with 2500 r. After induction, a dose of 25,000 r will not inhibit tissue differentiation. The cell will differentiate and the embryo will hatch. The time of x-irradiation, in relation to physiological processes is, therefore, of great importance.


Results on the response of Habrobracoon eggs to x-rays are consistent in indicating two kinds of changes in the cell: (1) chromosome alterations connected with the production of dominant and recessive lethal and visible mutations, and (2) a lethal cytoplasmic effect. In the Habrobracoon egg this cytoplasmic injury is constant with respect to dose for incidence and complete lethal action, regardless of the stage of the chromosome at time of treatment. It is concluded from the experimental data that x-rays can induce permanent changes in the egg cytoplasm, which may have a lethal effect on the egg without, however, inducing visible mutations in untreated chromosomes.

(Earlier work was reported as abstract in Genetics 35 (1950) 139-40, under the title "The non-induction of mutations by x-rayed cytoplasm")


Irradiated cytoplasm of Habrobracoon eggs was found to function normally after exposure to doses of x-rays many times greater than that lethal to the nucleus. High doses of radiation prevented normal function, even in combination with an unirradiated nucleus. The phenomenon of androgenesis was used as a source of evidence. (NSA 54: 1573, 1955)

1-B Genetic Effects
1-B-1 GENERAL

Surveys


Contents include a discussion of the limitations of the field (genetic changes investigated, mutagenic agents, chemical nature of the genetic material, influence of variables), radiation-induced mutations, dependence on dose, questions related to target and gene size, influence of ion density, structure of the gene, specificity of mutagenic agents, back mutations, sensitive stage for the induction of mutation, modifying factors, and radiomimetic effects of oxygen. Citations of work include data on Drosophila and Mammalia.


A very comprehensive review article, dealing with the nature of the induced arrangements (methods of diagnosis, types of induced chromosomal aberrations), the process of structural rearrangement (the breakage process), differences in sensitivity to ionizing radiations (relative sensitivity of different organisms, effect of plasmy), relative sensitivity of chromosomes in different types of cells of the same species, changes in sensitivity of chromosomes in cells of the same type, and chemical and cytogenetic studies. Many references to work on insects are included. Extensive bibliography, going back far beyond 1960.
TOPLASM IN HABROBRACON.

Indicating two kinds of changes in the mitotic and rescission lethal and visible g this cytoplasmic injury is constant (the stage of the chromosome at rays can induce permanent changes in however, inducing visible mutations under the title "The non-induction of X-RAY-INDUCED INJURY.

Currently after exposure to doses of x-rays lation prevented normal function, androgenesis was used as a source of

CHANGES IN THE DENSITY OF GENETIC MATERIAL. A REVIEW OF SOME CURRENT

Changes investigated: mutagenic effects, radiation-induced mutagenesis, ion density, structure of the chromosome for the induction of mutation; work include data on Drosophila and


Bombyx is one of the best materials for genetic research. Many findings of sex-determination, crossing-over, linkage analysis and artificial mutation correspond in general to those in Drosophila. A comparison of the two insects is therefore of interest. Based on a bibliographical survey, Tanaka's book "Genetics of Bombyx" (1955) mentions 1141 titles of papers which deal with Bombyx genetics, about 90% of which are Japanese. The genetics of Bombyx and of Drosophila were compared with respect to chromosomes, sex determination, linkage groups, crossing-over, physiological genetics, and practical applications. In physiological genetics, the excellent contribution of Yamasaki's biochemical studies and Morishita's developmental genetics were introduced. In practical applications, heterosis and induced mutations were discussed. Tsuzaki's discovery that the sexes in larval and egg stages may be distinguished with the help of induced mutations is of great importance for commercial purposes. (from BA 30: 305, 1958)

Muller, H.1 SOME PRESENT PROBLEMS IN THE GENETIC EFFECTS OF RADIATION. J. cell. comp. Physiol. 23 (Suppl. 1) (1956) 9–70.


The author presents a review of the research done on Drosophila, and the different implications of the results obtained. Different types of radiation are known to produce measurable different effects on the genetic system. Spontaneous and induced mutations are also discussed. Chemical effects are a further complication. Radiation damage in relation to cell cycle and susceptibility (as in spermatogenesis) represent complex problems of interpretation. Mention is made of numerous publications in which the general view of the action of radiation chemical mutations as well as their synergistic effect with the direct action of radiation is discussed.

Tanaka, Y., ed. GENETICS OF THE SILKWORM. Tokyo, Shokabō (1952). (In Japanese)

Very comprehensive work, particularly on Japanese research. More than 100 references, including much work on radiation-induced mutations.


Experiments are described which were designed to measure three criteria of radiation-induced chromosome breakage. These criteria were measured on three types of Drosophila sex chromosomes. Correct interpretation of experiments using ring chromosomes are discussed. (JNA 12: 15683, 1958)

Bonnier et al., 1952 - [1955]

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The observed mutations are dominant in the sense that they produce a phenotypic effect in heterozygous condition. Their effect in homozygous condition is not predictable from results which could be gene changes that only give a detectable effect in heterozygous condition. The variance increases more than the mean increases, indicating that both viability-increasing and viability-decreasing mutations have been observed and that a substantial number of each has been produced. A mutation rate of at least $1 \times 10^{-5}$/g or $1 \times 10^{-4}$/f is required to obtain a sufficient number of mutations to explain the variance increases.

(A paper of the same title has also appeared on p. 38 in "Proceedings of the 10th International Congress on Genetics, Montreal, 1958", Vol. 2, Toronto, University of Toronto Press, 1958)


Observations of x-rayed hanging-drop preparation of grasshopper neuroblasts in artificial medium at short time intervals immediately after treatment demonstrate that of the mitotic stages examined, namely, very late prophase, prometaphase, metaphase and anaphase, the earlier the stage, the greater the effect for a given dose. This may indicate either that a positive correlation exists between the degree of "stickiness" produced and the time interval available for it to develop between treatment and detection or that the susceptibility of the chromosomes to this effect diminishes as cells progress through the mitotic stages studied. (auth.)

(An abstract was published earlier in Radiation Res. 1 (1954) 461–2)

Clark, A. M. GENETIC EFFECTS OF X-RAYS IN RELATION TO DOSE-RATE IN DROSOPHILA. Nature 177 (1956) 787.

Using dose rates of 1000 r/min and 5000 r/min, it has been confirmed that, for a given dose, a greater amount of genetic damage is produced if the irradiation is delivered at high intensity. With a total dose of 2000 r, the high dose rate gives an increase of up to 25% in the yield of recessive sex-linked lethals and of translocations. The intensity effect is enhanced if the flies are injected with 0.005 M sodium azide in saline just prior to irradiation.


Available basic information on mating habits, etc. is reviewed. A preliminary assessment is made of the conditions under which induced mutations might be used to control the gypsy moth, Porthetria dispar (L.).

* Glass and Platte 1950 – 1997


Cells of the Drosophila germ tracts were exposed to multiples of 2000 r given on 0 d after emergence and at 14, 28 and 42 d thereafter. Eight days immediately following the first irradiation the percentage of sex-linked lethal mutations were: no radiation, 0.6; 2000 r, 0.5; 4000 r, 1.3; 6000 r, 1.9; and 8000 r, 1.8. A 14-d interval between irradiation of the germ cell sample had reduced the initial percentages to one-fifth, a 28-d interval to one-seventh, a 42-d interval to one-eleventh. The potential germ cell population has undergone biological improvement. To allow time for repair irradiations were spaced: 2000 r at 0 d; 2000 r at 14, 28, and 42 d; and 2000 r at 28, 42 d, giving an accumulated series of 2000, 4000, 6000 and 8000 r to each male. Sperm from these periods showed mutation rates of 4, 9, 52, 5.9 and 10.7% as contrasted with 3.6, 10.3, 13.5 and 18.3% where the corresponding irradiation dosages were received in single periods. The populations of repeatedly irradiated sperm recovered most of their normal characteristics before the following irradiation again raised the mutation percentages. Mutations in early germ cell lines appear to increase somewhat the observed lethals in the progeny of the 42-day males, clearing radiation damage.

Haas et al. 1950 – 1988


The translocation rate in Drosophila metaploids tested included the dose rate of $1 \times 10^{-9}$ r, $2 \times 10^{-5}$ r, $3 \times 10^{-5}$ r, $4 \times 10^{-5}$ r; damage was greater at $3 \times 10^{-5}$ r than at $4 \times 10^{-5}$ r. Damage was induced in $O_{4}$, $O_{3}$ and $O_{2}$, other factors which influence damage.


Female Drosophila were treated with the following dose rates $1 \times 10^{-9}$ r, $1 \times 10^{-8}$ r, $1 \times 10^{-7}$ r, and $1 \times 10^{-5}$ r. Individual flies may be considered to be more frequently after x-irradiation.

Henshottowitz 1964 – 1897

Henshottowitz 1957 – 1987

Henshottowitz and Abrahamson 1957

* Henshottowitz 1958 – 1967

* Hollander et al. 1958 – 1967

Kaufman and Wasserman 1958

Keyf, H.-G. UNTERSUCHUNGEN ZU DEN STRUKTURÄNÄCHERUNGEN VON RÖNTGENSTRahlEN UND STRUKTURÄNÄCHERUNGEN VON CHROMOSOMEN. Z. Phys. 86 (1933) 44.

Embryos of Chironomus thumari exposed to x-rays, and the resultant male progeny (deletion with open fragments) were scored for the possible recovery of the experimental data collected.

Koizumi 1957 – 1967


Fundamental genetic research, prokaryotes, and some spontaneous ones in the Culex pipiens complex.
GENETIC EFFECTS OF LOW DOSES
and UN International Conference on
15-9,

dominant effect in heterogeneous
results which could be gene
The variance increases are more
using and viability-decreasing
been produced. A mutation rate
number of mutations to explain the
10th International Congress on
as. 1959)

ON THE CHROMOSOMES OF THE
IC STAGE AT TREATMENT.

us in artificial medium at short
otic stages examined, namely, very
stage, the greater the effect for a
between the degree of "stickness"
entmodation or that the
ress through the mitotic stages
rate in Drosophila. Nature 177
that, for a given dose, a greater
high intensity. With a total dose of
recurrent sex-linked lethals and
ated with 0.006 M sodium azide in

CONTROL OF INSECTS BY
iminary assessment is made of the
gypsy moth, Porthetria dispar (L.).

EFFECTS AS RELATED TO
in Genetics, Montreal 1958".

200 r given on 0 d after emergence
the first irradiation the percentage
000 r, 10, 3; 6000 r, 13.5; and
sample had reduced the initial
event to one-eleventh. The

to allow time for repair irradiations
62 d, giving an accumulated
these periods showed mutation
and 18.9% where the corresponding
repeatedly irradiated sperm re-
ation again raised the mutation
what the observed lethals in the
progens of the 40-day males receiving higher irradiation dosages. Biological recovery has significance in
clearing radiation damage from both the soma and populations of germ cells.

Hass, E. et al. 1952 - [1388]

Hass, F. L., Dodgeon, E., Clayton, F. E., Stone, W. S. MEASUREMENT AND CONTROL OF SOME
The translocation rate in Drosophila virilis was used to measure the biological effect of x-radiation. Vari-
ables tested included the dosage rate, the temperature, and the gaseous environment (O2, mixtures of
O2+N2, O2+CO2, O2+CO, O2+CO+CO2) of the organisms during irradiation. It was found that x-radiation
damage was greater at 3 ± 2°C, and with a fast dose rate (about 1000 r/min) than a slow (100 r/min).
More damage was induced in O2, CO+O2, and CO+O2, than in air or 96% N2+4% O2. The amount of O2 and
other factors which influence the oxidative metabolism of the cell modify the radiation damage.

(SA 53: 1955)

Henikowits, L. H. THE RELATION BETWEEN X-RAY DOSAGE AND THE FREQUENCY OF SIMULATED
HEALING OF CHROMOSOME BREAKAGES IN DROSOPHILA MELANOGASTER FEMALES. Proc. nat. Acad.
Female Drosophila were treated with two different dosages of x-radiation, and the number of exceptional
flies, individuals of appropriate types were determined. Analysis of the data indicates that all the exceptional
flies may be considered to carry gross chromosomal rearrangements, and that gross rearrangements occur
more frequently after x-irradiation of oocytes than after x-irradiation of oogonia.

(NSA 8: 5474, 1954)

* Henikowits 1954 - [1192]
* Henikowits 1957 - [1195], [1196]
* Henikowits and Abrahamson 1957 - [1199]
* Henikowits 1958 - [1200]
* Hollaender et al. 1952 - [1290]
* Kaufmann and Wasserman 1957 - [1121]

Kiel, H.-G. UNTERSUCHUNGEN AM KARYOTYPUS VON CHROMONUS (L. TENDIPEST THUAMU.
II. STRUKTURVERÄNDERUNGEN AN DEN SPEICHELDRÜSEN-CHROMOSOMEN NACH RONTGENBESTRA-
LUNG VON EMBRYOGEN UND LARVEN (Studien on the karyotype of Chironomus (L. Ten dipes) thum.
II. Structural modifications of the salivary gland chromosomes after x-irradiation of embryos and larvae).
Chromosoma 9, 6 (1956) 441-83. (In German)
Embryos of Chironomus thummi thummi at 4 different stages and larvae up to 160-h-old were irradiated with
x-rays, and the resultant modifications are described. The most frequent types of 3-break-recombination
(deletion with open fragment, and open inversion) show different distributions of inter-break-spacing. Some
deductions on the possible structure of the embryonic salivary gland chromosomes may be made, based on
the experimental data collected.

* Kolwai 1957 - [1204]

Ottawa, Montner Ltd. 1956.
Fundamental genetic research in Culicidae is desirable for several reasons, e.g. for the study of crossing
relations in the Culex pipiens complex, for the problems of susceptibility to infection, resistance to in-
secticides and others. Several mutations have been produced in Culex pipiens by means of x-rays. These
and some spontaneous ones are enumerated. The phenomena associated with reproductive incompatibility
in the Culex pipiens complex are briefly reviewed. By means of marker genes it could be demonstrated that

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the crossing type is determined by extra-chromosomal cytoplasmic factors. This intrinsic incompatibility mechanism seems to be a specific mechanism of evolution in Callicidse. (auth.)


A new type of position effect called the "trans-vection effect" permits rapid and highly efficient detection of chromosomal rearrangements in the first generation following an induction treatment. By the use of this new method fast (plus) neutrons have been found to be more effective than X-rays or γ-rays in producing re-arrangements in Drosophila, and estimates of the dose of fast neutrons at different stations during a nuclear detonation have been derived. (from auth. summary)


The relation between sex ratio and dose was used to investigate the effect of sex chromosome constitution on sperm sensitivity. As has been repeatedly demonstrated, irradiation of a normal male has little or no effect on the sex ratio of its progeny, suggesting nearly equal sensitivity of X-bearing and Y-bearing sperm. In irradiation of XY males produces a slight shift in XX/XY from 0.896 with no irradiation to 0.896 with 4000 r, whereas irradiation of XO males produces a spectacular shift in ratio from 0.748 with no irradiation to 0.435 after 4000 r. These observations have been interpreted to indicate that (a) XY-bearing sperm are much more sensitive than XO sperm, (b) Y-bearing sperm are considerably more sensitive than nullo-X, nullo-Y sperm, and (c) since X- and Y-bearing sperm exhibit similar sensitivity, X-bearing sperm are also considerably more sensitive than nullo-X, nullo-Y sperm. (from auth.)

Luce, W. M. REDUCTION IN FACET NUMBER IN FULL-EYED (REVERTED BAR) DROSOPHILA BY X-RAYS. (abstr.) Genetics 50 (1955) 563.

Gonads of an inbred full-eyed (reverted to full from bar) strain of Drosophila melanogaster, kept at 24°C, were treated with X-rays dosages ranging from 1000 to 5000 r applied at the rate of 500 r per min. The gonads of the flies which developed from the treated larvae were dissected out, mounted on slides, projected, and the facets counted. The x-rays produced a reduction in facet number. The rate of reduction was approximately 0.075 percent per r. The x-rays when applied before the larvae were 56 h old (postmolt of the time the larvae were laid as eggs) had no effect. Larvae treated at any time when they were from 50 to 80 h of age responded with essentially similar rates of reduction in facet number per r applied, with some evidence that the rate was less for the lowest dosage used (1000 r). The x-rays caused the larvae to develop, approximately 0.611 h per r, appeared nearly constant for all x-ray applications within the age limits (38-80 h) used in this experiment with the qualification that the 3000 r treatment had a slightly diminished effect on the rate of development.

Luce et al., 1955 - [870]


This study concerns the possible mutational adaptation due to incorporation in the population of mutational isolates with lower mutability than the alleles originally present. A comparison was made between the rates of recessive lethals and X-m and Y mutants induced by X-rays in males from Drosophila melanogaster stocks kept at normal background radiation versus those under constant γ-irradiation (0 r/hr). No difference in mutability was found between these two stocks, and hence there are no indications of mutational adaptation due to mutational isolates. These negative results do not exclude a possible mutational adaptation, or recovery phenomenon, which is discussed. (auth.)

(A report of the same title has also been published in A/AC. 82/G/R. 69, Stockholm, Univ., Int. Genetics, 1957, 17p)

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On the expectation that the new investigators have irradiated several Drosophila melanogaster in chromosome types yield similar stocks were constructed which demonstrate chromosome deletion spermatogenesis containing either X-rayed rods yielded 46/138 436/3605 for 4000 r, while the 31/501 for 2000 r; 187/2201 more lethals were recovered than induced in the rod-X (15/11) being 2/41 934 for rods and circular frequency in both stocks, results in a greater loss of those of rod-shaped chromosomes. (Abstract of paper presented at 1966)

Parker, D. R., McCrone, J. OOCYTES OF DROSOPHILA. The technique of detachment processes in Drosophila females.


Gononia punctifrons males were independent of the intensity of counts on cells in anaphase I there data with respect to the (from abstr.)

Ray-Chaudhuri et al., 1957 - [907]

Schmidt, W. SIND DIE STRUKTUR-GECHENES DES melanogaster significant for quantitative studies of Drosophila. (In German)

Applications of data on dominant mutants in quantititative radiation genetic studies on Drosophila are discussed. (N.A. 13: 167)

Strangio, V. A. A STUDY OF RECOVERY OF LETHAL IN DROSOPHILA. Aust. J. 1.

Sixty-eight sex-linked, recessive lethals were divided into all the lethals were individually treated in a mental cycle. The relative frequency of an approach was used to measure the relationship between the time of the chromosomal abo

On the expectation that the morphology of the chromosomes may affect their radiosensitivity several investigators have irradiated ring-shaped chromosomes and ordinary rod-shaped ones in spermatogonia of Drosophila melanogaster. In general, they found that although rings are lost more often than rods, both chromosome types yield similar lethal mutation frequencies. To investigate further this problem special stocks were constructed which permitted the simultaneous detection of lethal mutations, genetically demonstrable chromosome deficiencies, and nonlethal visible mutations. Homogeneous samples of spermatogonia containing either ring- or rod-shaped sex chromosomes were treated in inseminated females. X-rayed rods yielded 46/1063 (i.e., lethals among treated chromosomes) for 1000 r, 65/1280 for 2000 r, 426/3093 for 4000 r, while the controls gave 41/1068; X-rayed rings yielded 44/1063 for 1000 r, 31/501 for 2000 r, 187/2201 for 4000 r, while the controls gave 14/4997. With high doses significantly more lethals were recovered from rods than from rings. Significantly more chromosome deficiencies were induced in the rod-X (16/17438) than in the ring-X (6/15300) by 4000 r, the control counts for deficiencies being 1/41524 for rods and 0/29504 for rings. Nonlethal visible mutations were rare and induced in similar frequency in both stocks, there being none among controls. Thus treatment with high doses of X-rays results in a greater loss of those associated with structural changes in the case of ring-shaped than of rod-shaped chromosomes. These findings supply additional evidence against the view that point mutations originate via the restitution of chromosome breaks.


956 Parker, D. B., McConne, J. A GENETIC ANALYSIS OF SOME REARRANGEMENTS INDUCED IN OOCYTES OF DROSOPHILA. Genetics 43 (1956) 172-86.

The technique of detachment of attached-X chromosomes has supplied a means of studying translocation processes in Drosophila females. The analysis was based on data obtained from x-irradiation.


Gesoria punctifrons males were subjected to X-rays from 8a. The frequency of bridges were shown to be independent of the intensity of radiation within the limits of the experiment (80 r given in 3 h or 23 h), but the rate of reduction in facet number usage rose (1000 r). The X-rays at 0.013 r per hr, appeared nearly to this experiment with the quality of prolongation.

958 Schmid, W. SIND DIE SCHICHTEMBEN MUTATIONEN BEI DROSOPHILA MELANOGASTER FUR QUANTITATIVE STRAHLENGENETISCHER UNTERSUCHUNGEN GESEHEN? (Are the visible mutations in Drosophila melanogaster significant for quantitative radiogenic investigations?) Strahlentherapie 109 (1959) 73-96. (In German)

Applications of data on dominant and recessive viable mutations and gynandromorphs in Drosophila melanogaster in quantitative radiation genetic experiments are discussed. Data are reviewed from a number of genetic studies on Drosophila. Somatic mutations and modifications, as well as induced somatic crossing-over, are discussed. (NSA 13: 16727, 1959)


Sixty-eight sex-linked, recessive lethals were recovered following the irradiation of Drosophila males with 2150 r, 31 at the dose-rate of 2000 r/min and 3 at 100 r/min. Except for the rare extended phase lethal, the lethals were individually stage specific and also tended to group about sensitive stages in the developing cycle. The relative frequencies of these lethal clusters tally with previous published estimates. A cytogenetic approach was used to interpret one such exceptional lethal. Some evidence already exists for a relationship between the time of onset of genetically-induced developmental abnormality and the magnitude of the chromosomal aberration involved. Intensity differences are responsible for a differential yield.
of gross rearrangements. An attempt to demonstrate a more obvious embryonic trend in the sensitivity pattern of the high dose-rate lethals mirroring this intensity effect was unsuccessful. Visible abnormalities associated with the lethals were tabulated. (auth.)


Wallace 1956 - [1459]


Eighty-seven freshly emerged females were mated and kept without food until only oogenesis and very young oocytes remained in their ovaries. They then fed and oviposited on host Eustisius caterpillars immediately after these had been x-rayed with doses ranging from 40,000 r to 100,000 r. They were transferred every third day to freshly irradiated caterpillars. No evidence of a lethal effect of irradiated food was observed. Females appeared reluctant to sting and feed on most heavily irradiated hosts although they did so. It is evident that heavily irradiated host caterpillars exerted no mutagenic effect on the parasite. (from auth.)

1-8-2 INDUCED MUTATIONS

Survey


Results are reported from a series of studies on the biological effects of x-radiation and the chronic effects of neutron irradiation. Amongst many others, experiments on the relation of mutation frequency to x-radiation dose in Drosophila are reported. Amongst chronic irradiation with y-rays at low doses on the mutation rate in Drosophila is considered. A list of references is included with each chapter, and a complete subject index is provided.


Review article, freely illustrated with data from Drosophila.


Review article. The nature and incidence of induced gene mutations are discussed, and the estimation of genetic damage. Work is cited on Drosophila, also on grasshopper. General bibliography: 121 refs.
orygenic trend in the sensitivity to irradiation and the chronic effects of mutation frequency to x-ray. Y-rays at low dosages on the males with each chapter, and a complete list of references (in p. 575-6 in TID=7554, Symposium on the Peaceful Application, N.Y.) is discussed, and the estimation of 121 refs.

966 Alexander, M. L. X-RAY INDUCED MUTATION RATES AT SPECIFIC LOCI ON THE THIRD CHROMOSOME OF DROSOPHILA MELANOGASTER. (abstr.) Genetics 37 (1952) 563. The mutation rates were obtained both for irradiated spermatogonia and mature sperm. Special techniques were employed: (1) to limit the sperm sample from treated adult males, (2) to detect "spontaneous cluster" mutations, (3) to assure samples from treated spermatogonia by use of early larval stages. An average rate of $5.67 \times 10^{-4}$ mutations per r per locus is reported in some 50,000 flies tested the effects of 3000 r of x-rays on the 8 loci of the r group of mutations. The rates per locus varied from 1.36 to 8.75 x $10^{-4}$ per r. The induced mutations from treated sperm were lethal, semilethal, viable, or phenotypically normal when tested in the homozygous condition. No mutations were observed in the unirradiated sperm. (From abstr.)

967 Atwood, J. C., Bonser, R.C. von, Whiting, A.R. AN INFLUENCE OF PLIOID ON THE TIME OF EXPRESSION OF DOMINANT LETHAL MUTATIONS IN HABRoBRACON. Genetics 41 (1956) 804-13. The frequencies of x-ray-induced dominant and recessive lethal mutations in Habrobracon oocytes are unchanged by subsequent fertilization with unirradiated sperm. A significant proportion of the dominant lethal effect induced at metaphase I is expressed at a later stage in diploids than in haploids. When dominant lethals are induced at prophase I, the proportion expressed after hatching is the same in diploids as in haploids. The dependence of delayed expression on the stage irradiated is consistent with the assumption that lethality caused by observable chromosome breakage can be delayed, whereas that due to other causes cannot. Chromosome breakage is apparently a more frequent cause of lethality after irradiation of oocytes in metaphase than in prophase. (Author summary)

968 Baker, W.K., Hal, E.S. von. THE PRODUCTION OF DOMINANT LETHALS IN DROSOPHILA BY FAST NEUTRONS FROM CYCLOTRON IRRADIATION AND NUCLEAR DETONATIONS. Science 119 (1954) 46-9. Data are presented on the relative biological effectiveness of fast neutrons from cyclotron irradiation and from nuclear detonations as determined by means of induction of dominant lethals in Drosophila. It is concluded that the frequency of dominant lethals may be useful as a rather rapid, but crude, biological measurement of fast neutron dosage at high levels. Findings are compared with similar data on Tradescantia. (N.B. 8: 3655, 1954)

* Bateman and Sinclair 1919 - [379]
* Bateman 1919 - [312], [378]
* Bateman 1915 - [1172]

Drosophila eggs and larvae at different stages were subjected to x-rays which caused changes that ultimately led to spots in the adult eye. An interpretation of the complex processes involved is attempted. It appears that the definite delimitation of the eye occurs certainly not earlier than at the end of the 2nd larval stage.

Belovsky 1958 - [1776]

Belovsky et al. 1969 - [1776]


A recessive x-ray mutation is described. Its gene lies in the left arm of the second chromosome. The papal development is normal, but the papal covering is twice the normal thickness, the protein and not the chitin sheath being thickened. As a result, when entering its covering the hemolymph has lost, apparently through an opening in the anterior wall of the thorax, and the animal dies. If carefully removed by hand, the apparently normal fly survives and is fertile, but its offspring are 66% lethal, the remainder escaping normally. The thickened papilla is thus the only apparent abnormality.

Bertram and Hohne 1958 - [814]

Bertram et al. 1960 - [1771]


Work is reviewed which has been completed to date on the induction of mutations in Drosophila by indirect x-irradiation.

Bonnier, G. SECONDARY INFLUENCES FROM X-RAY IRRADIATION ON MUTATIONAL PROCESSES IN DROSOPHILA MELANOGASTER. Hereditas 5 3 (1954) 199-210.

It is shown that certain aberrations occurring in irradiated paternal X-chromosomes are produced at a higher rate when the chromosomes are irradiated in impregnated females than when they are irradiated in males. It is furthermore shown that the rates are dependent on the strain from which the females, which harbour the sperm, are taken. In one instance it was also found that the rate of fractions due to breaks in the paternal chromosomes produced by irradiation of males was enhanced if the females were irradiated, prior to mating.


Spermatozoa in D. melanogaster may be irradiated in males or in impregnated females. In studies which were begun some years ago it was found that sex-linked lethals were produced in male gametes at a slightly higher rate when the treatment was given to impregnated females, confirmed in experiments on a larger scale. The differences in the rates, though still small, were clearly significant. It was further found that other mutational processes also obey the same rule. Dr. Luttinger has investigated the nature of those processes which show the mentioned differences in rates. When irradiating male spermatozoa containing the "Mueller-5" X-chromosome, breaks in this chromosome produce, after mating the males to yellow females, fractional yellow females at a low rate. This rate was slightly, but significantly, increased if the females as well were irradiated — even if before mating. This effect was, however, influenced by the

Bonnier, G. RATE OF DEVELOPMENT IN SELECTED PRESSURE. p. 4 Conference on Radiobiology, J. D., eds. London, Oliver and Boyd 1959.

Some preliminary experiments showed that the rate of development was inhibited by x-irradiation.

Bonnier, G., Jonsson, U.-B. SOME OF DROSOPHILA MELANOGASTER. A study is reported on problem of melanogaster. The frequency is some cases also combined into a discussion of the variance into its components, concerning the study and the


Wild-type males of D. melanogaster, maximum age of 3 days, of the stock was studied after various conditions in irradiation and fertility rate, and the declining of hatching rate of between 30 and 100% of the hatched state of 80% of the males prior to irradiation.


It is shown that x-ray irradiation reduces the fertility of the irradiated individuals, but may perhaps be due to a general decrease in the reproductive system of the females as well.


In Drosophila melanogaster, an unirradiated female with two copies of the irradiated X-chromosome may exhibit segregration of the mutant allele at a much higher rate than in the case of a single copy of the mutant allele.


Spermatozoa in D. melanogaster may be irradiated in males or in impregnated females. In studies which were begun some years ago it was found that sex-linked lethals were produced in male gametes at a slightly higher rate when the treatment was given to impregnated females, confirmed in experiments on a larger scale. The differences in the rates, though still small, were clearly significant. It was further found that other mutational processes also obey the same rule. Dr. Luttinger has investigated the nature of those processes which show the mentioned differences in rates. When irradiating male spermatozoa containing the "Mueller-5" X-chromosome, breaks in this chromosome produce, after mating the males to yellow females, fractional yellow females at a low rate. This rate was slightly, but significantly, increased if the females as well were irradiated — even if before mating. This effect was, however, influenced by the

Some preliminary experiments on Drosophila and their results are reported. A growth rate index is used. Several detrimental, though perhaps not all, could have been picked out by their average rates of development alone.


A study is reported on problems concerning x-ray induced subvis in the second chromosome of D. melanogaster. The frequency of such viability mutations are considered, and the comparisons made are in some cases also combined with the effects of different degrees of environmental stresses. The study is divided into a discussion of the material used, estimates of the frequency of subvis, partitioning of the variance into its components, discussion on survival rates, larval competition tests, and considerations concerning the study and the structure of irradiated populations.


Wild-type males of D. melanogaster were irradiated with about 2000 r and mated to y w+m females of a maximum age of 3 d. Corresponding controls (without irradiation) were available. The hatchability of the eggs was studied after varying the age of the males at fertilisation and after varying the length of time between irradiation and fertilisation. It was found that both these factors were active in decreasing the hatching rate. The decline ranged from about 50% to about 90% or still lower. In the controls a normal hatching rate of between 80 and 90% was found without any effect from aging the males. Unmated or mated state of the males prior to the present mating had no effect on the hatchability. (from auth.)


It is shown that x-ray irradiation of male X-chromosomes of D. melanogaster produces a higher rate of recessive lethals if the irradiation is given to spermatocytes which are stored in impregnated females than if the irradiation is given to males. This effect is probably not caused by the irradiation per se of the females, but may perhaps be due to a difference in the state of the spermatocytes when being within the seminal receptacles of the females as compared with their state within the males. (auth. summary)


In Habrobracon, unfertilized eggs develop normally to become haploid males; fertilized eggs become diploid females. Females which had stored eggs in the first meiotic metaphase were x-irradiated and one half of them subsequently mated. The fertilized eggs had a much higher hatchability frequency than the unfertilized eggs; however, adult survival did not differ markedly in the two groups. The higher frequency of death during the larval stage in the diploid embryos accounts for the difference. Those mutations which cause death of diploid embryos at a later stage of development than haploid embryos are referred to as conditionally delayed dominant lethal mutations; up to 25% or more of dominant lethals can be of this class in eggs irradiated in metaphase 1. Examination of unfixed dead embryos also shows that fertilized eggs die at later stages than do unfertilized ones when the eggs are irradiated in either the first meiotic metaphase or prophase, but a higher proportion of eggs, fertilized and unfertilized, die early in the latter case. Conditionally delayed dominant lethals by criterion of hatchability do not occur to any appreciable extent when eggs are irradiated in the first meiotic prophase.

(Abtract of paper presented at the 1955 meetings of the Genetics Society of America, East Lansing, Michigan, 6-8 Sep., 1955)
On the Nature of Radiation-Induced Dominant Lethal Mutations in Habrobrotula and Drosophila. Genetics 41, 1956 668.

In Habrobrotula and Drosophila, induction of the breakage-fusion-bridge cycle with consequent gene imbalance has been considered as the primary source of dominant lethality. Habrobrotula eggs irradiated in the first meiotic metaphase show terminal deletions that result in bridges in the second meiotic anaphase and bridge-breakage during cleavage. Since the breakage-fusion-bridge cycle does not appear to become established in eggs irradiated in the first meiotic prophase, the question arises as to the cause of dominant lethality in these eggs. Examination of dead Habrobrotula embryos from irradiated eggs (unfertilized, or fertilized subsequent to X-irradiation) at about the 50% lethal dose (15,000 r) shows that approximately 90% have been blocked in development at the sixth or seventh cleavage and the nuclei are Feulgen negative. Thus it appears that dominant lethality in these eggs is associated with interruption of deoxyribonucleic acid synthesis. Approximately 90% of dead Drosophila embryos from irradiated sperm (ca 50% lethality; 2000 r) die under similar circumstances. These resemble the specific lethality in Habrobrotula in that death occurs during the early cleavage stages. In order to test whether this action is caused by induced chromosomal deletions, the dead embryos from unirradiated triploids were examined. The chromosome complements of such embryos comprise a variety of aneuploid types. Since all eggs from Habrobrotula triploids and most eggs from Drosophila triploids died during later development, it appears likely that radiation-induced dominant lethal mutations are not necessarily brought about by induction of chromosomal deficiencies. In particular, those lethals associated with the radiation effect on deoxyribonucleic acid synthesis in Habrobrotula are clearly not the result of chromosomal deficiencies.


Comparison of Radiation-Induced and Genetically Contrived Dominant Lethality in Habrobrotula and Drosophila. Genetics 45, 1957 401.

In Habrobrotula and Drosophila most of the deaths from irradiation of eggs and sperm occur early in embryonic development before the blastoderm is formed. The problem exists whether this early type of radiation-induced lethality can be attributed to gene imbalance. A solution to this problem may be reached by determining the time of death of viable progeny of triploids or translocation heterozygotes. It has been found that aneuploid embryos from Habrobrotula and Drosophila females die after blastoderm formation unlike the majority of radiation-induced dominant lethals. Corroborative evidence was obtained from examination of dead embryos from heterozygotes of two different Drosophila translocations and four different newly induced Habrobrotula translocations; it was found in each case that death is expressed after blastoderm formation. Since aneuploidy in neither Drosophila nor Habrobrotula brings about death during early development that is most characteristic of radiation-induced lethality, it appears that radiation induces in large measure a type of dominant lethality that is not attributable to the loss of chromosomes or chromosome parts resulting from chromosome breakage.

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


In the parasitic wasp Habrobrotula, unfertilized eggs become normal haploid males; fertilized eggs, diploid females. Three types of dominant lethal mutations have been identified in Habrobrotula. Type I dominant lethality kills the embryo during the first few cleavages and is believed to represent a defect in deoxyribonucleic acid synthesis. These account for 60-80% of the deaths when eggs or sperm are irradiated and Type I lethality is unaffected in expression by fertilization. Type II kills the embryo after blastula formation and before the embryo hatches if the embryo is haploid, after hatching if the embryo is diploid. These are called conditionally delayed dominant lethal mutations and are characteristic, with Type I, of Habrobrotula eggs irradiated in the first meiotic metaphase. They are believed to be manifestations of chromosome imbalance. Type III kills the embryo after blastula formation and before hatching whether the embryo is haploid or diploid. Death may occur later in embryogenesis in the diploids than in the haploids, but always before hatching. Type III, with Type I, is characteristic of Habrobrotula eggs irradiated in the first meiotic prophase. In Habrobrotula, live translocations, when heterozygous, produce aneuploid embryos that all died under the same circumstances that characterize Type II dominant lethality. Type III dominant lethals are exactly mimicked by aneuploidy. Radiation-induced dominant lethals remains specifically inducible of Type I and Type III have been observed by aneuploidy from triploid female radiation. Even Drosophila is the associated nuclear development.

Bontel, R. C. von, Reiney, R. L. Lethality in Habrobrotula. Three kinds of dominant embryos in Habrobrotula, a similar situation to the paper. Although lethality induced by radiation in Habrobrotula is not mimicked by aneuploidy.

Bontel 1960 - (1480)


In the wasp Habrobrotula it was found that at least three types distinguish the situation by radiation. The most common type of dominant lethality is the slowest to the rate of auxin. The slowest of the rates is the nucleic organizer but can be determined by any other action of radiation. (auth.)

Brandt and Hoenne 1960 - (1485)

Brandt and Hoenne 1960 - (1486)

Buzza-Traverso, A. A. On the origin of the International Congress, G., Chiangi, A., eds. F.

It was shown that, under the assumption rate proved a disadvantage to genetic implications of these observations.

Buzza-Traverso and C. Seriche

Carpari, S. B. AN X-RAY S MORMONIELLA. Radiation.

A study of mutants and mutations of 1000 to 5000 r of wild-type wasps found the following: 6, O, recessive lethal. 

Clark, M. N., Rubin, M. A., et al. MATURE SPERM OF HABROBROTTUS Males from stock No. 1 were 1150 to 58500 rep. At a dose of males with 7000 r showed -
are exactly mimicked by aneuploid embryos from triploid Habrobracon females, indicating that Type III radiation-induced dominant lethality may be caused by chromosome loss. Type I dominant lethality remains specifically inducible only with mutagenic agents. In Drosophila, dominant lethal analogues of Type I and Type III have been observed following X-irradiation. Type III is mimicked in Drosophila by aneuploids from triploid females or translocation heterozygotes. Type I is specifically induced by radiation. Even Drosophila aneuploids deprived of genetic means of the X and Y chromosomes and lacking the associated nucleoli develop further than Type I dominant lethal embryos.


These three dominant embryo lethals, distinguished phenotypically, are induced by radiation in Habrobracon, a similar situation exists in Drosophila but only two-kinds are distinguished by the criteria specified in the paper. Although chromosome imbalance phenomena can mimic some of the dominant lethality induced by radiation, the majority of radiation-induced dominant lethals in Habrobracon and Drosophila are not mimicked by genetically contrived loss of chromosomes or loss of chromosome parts.

Borstel 1960 - [1436]


In the wasp Habrobracon it was found that radiation-induced dominant lethality is a complex consisting of at least three types distinguished phenotypically and genotypically. In Drosophila, two types are phenotypically distinguishable. By comparing radiation-induced with genetically contrived dominant lethality, it is possible to show that one of the three types of dominant lethality can be attributed to chromosome imbalance and that another type is possibly caused by chromosome loss or severe chromosome imbalance. The most common type of dominant lethality appears to be caused by excessive depression of the mitotic rate. The slowing of the rate of mitosis does not appear to be caused by inactivation of the nucleolus or nucleolar organizer but can be brought on by induction of the breakage-fusion-bridge cycle. It is possible that any other action of radiation that depresses the mitotic rate will also induce this type of dominant lethality. (auth.)

Brandt and Höhne 1962 - [1972]

Brandt and Höhne 1963 - [815], [816]


It was shown that, under the experimental conditions described, an artificially X-ray-induced raised mutation rate proved an advantage to the Drosophila population and raised its productivity. The evolutionary implications of these observations are discussed.

Bussati-Traverso and Scorniello 1958 - [1437]

Caspari, S. R. AN X-RAY SPERM-DOSE-ACTION CURVE FOR MUTATIONS AT A SINGLE LOCUS IN MORMONELLA. Radiation Res. 8, 2 (1959) 273-83.

A study of mutants and mutation rates for a single locus, R, in Mormonella was made by x-raying 40 doses of 1000 to 5000 <i>R</i> wild-type males, mating them to females of a double recessive peach stock, and counting and analyzing the mutants appearing among the <i>F<sub>2</sub></i> daughters. Analyses were made for four kinds of mutations: S, O, recessive lethals and recessive sterile. (from auth. summary)


Males from stock No. 1 were irradiated with 40 MeV alpha-particles from a cyclotron at doses ranging from 1100 to 68,500 rep. At a dose of 6700 rep, 39% of the sperms carried at least one dominant lethal. X-irradiation of males with 7000 r showed that 99% of the sperms carried at least one dominant lethal. These
x-ray data are comparable to those reported by Heldenthal (1945). Thus, for equal exposures of energy, the same number of dominant lethals are obtained for α-particles and for x-rays.


Selection for abdominal chaetae has been carried out in an inbred line of D. melanogaster, both with and without irradiation by 3800 r x-rays of each generation. The response in the control stocks in 17 generations was not significant. The irradiated lines responded to selection but slowly compared with wild populations. This is discussed in relation to the results of other workers. Two papers by Mather and co-workers are found to give consistent estimates of the rate of spontaneous production of new variance in abdominal chaetae of the order of 0.01 units each generation, which is not inconsistent with our results. The variance found in several wild populations is about 5 units. The evolutionary aspect of these results is discussed. (auth. summary)

Colombo, G. PRIME RICERCHE SUI LETALI DOMINANTI INDOTTI DAI RAGGI X SU MASCHI DI LOCUSTA MIGRATORIA MIGRATORIOIDES R. E F. (ORTHOPERA) (Initial research on the dominant lethals induced in x-rays on the males of Locusta migratoria migratorioides R. and F. (Orthoptera)). Ric. Sci. 22, 10 (1959) 223-41. (In Italian)

Males of L. m. migratorioideae at 4th instar, just after the last moult and a month after the last moult were irradiated with x-rays from 50 to 1000 r. The irradiated males were mated to non-irradiated virgin females and the offspring scored for embryo mortality. Dominant lethals induced in spermatogonia, spermatocytes and sperm were studied. The relation of dosage to effect, for dominant lethals induced on sperm, follows a one-event curve; but it is possible that doses high enough to produce multi-event effects were not used. The sex ratio was observed to be altered in favour of males. The frequencies of dominant lethals increase when more mature germ cells are irradiated. This result is explained as cell selection against germ cells irradiated in premeiotic and meiotic stages. This view is supported by several experiments on chromosome and cell damage by x-rays on Orthoptera. The percentages of embryo death at different stages of development were determined. When sperm were irradiated there was a higher mortality during segmentation, whereas when spermatogonia were irradiated mortality was higher in later stages of the embryonic development. This result is considered to be further evidence of cell selection against germ cells irradiated during premeiotic stages. (auth. summary)

Cunha et al. 1958 - [1459] 1440]

Cunha et al. 1959 - [1441]

Dittrich, W., Höhne, G., Paul, W., Schubert, G. ÜBER DIE AUSLÖSUNG REZESSIV-GESCHLECHTS-GELENDENER LETALFAKTOREN BEI DROSOPHILA DURCH SCHNELLLE ELEKTRONEN EINES 6 MEV- \( \gamma \)-STRATONS (Production of recessive sex-linked lethals in Drosophila by fast electrons of a 6 MeV betatron). Naturwissenschaften 37, 93 (1950) 545-6. (In German)

Fast electrons (>3 MeV) were found more effective in inducing recessive sex-linked lethal mutations in D. melanogaster than equal x-rays doses in experiments of Timoshenko-Breslau (1944) and others. This difference, however, is not statistically significant. Spontaneous mutations of this kind did not occur, (BA 96: 17130, 1950)

Edington, C. W. A NONLINEAR FREQUENCY*DOSE RELATION FOR RECESSIVE LETALS INDUCED BY \( \gamma \)-RAYS IN DROSOPHILA. Genetics 41 (1956) 640.

It has been found that the frequency of recessive lethals induced by \( \gamma \)-rays in Drosophila melanogaster increases more rapidly with increasing dose than is expected on the basis of linearity. This nonlinear increase may be due to the increasing frequency at higher doses of one, two, or all of the following two-bait genetic effects: (1) two independent semilethals, which together act as a recessive lethal, (2) gross deficiencies, and (3) "position-effect" lethals, which are dependent on gross chromosome aberrations for their expression. (From abstr.)


Edington 1956 - [818]

Edington 1958 - [1377]

Endman 1960 - [897]

Falk, R. STUDIES ON X-RAYS IN DROSOPHILA MELANOGASTER

An isogenic Drosophila stock was isolated in such a way that viability mutations. Hatchling effect of the mutations in the subvital mutations only were not affected in their viability. A lethal. Among the subvital mutations the effect was partial.

Falk, R. STUDIES ON X-RAYS IN DROSOPHILA MELANOGASTER

Subvital mutations were induced some mutations only were only substantial than the lethals. These mutations with the lesser effect, the effect was partially or completely regression was the less dominant.

Fritsch-Maggi 1956 - [223]

Глебовский, Я.Л., Абакинова НА ЧАСТОТУ ЗОЛОТОВОДЧЕСКИХ БУКСАМ ОБЩЕЙ ЭКЗОЛОГИИ 2

1. Облучение \( \gamma \)-лучами в хорошо сращенных лабораторных \( \gamma \)-лучах с полуперекрестными мутагенными люком, индуцированными в операционных неизмененных, полученными другими методами. 2. Определяют контрольный \( \gamma \)-лучи, как и опытные максимальный дозы радиации \( \gamma \)-лучи, так и в биоте и до 5 р окулают в опыты, а затем определяют смертность и выявляют, насколько больших типов мутаций в природе организмов.

Glebovskiy, Ya.L., Abakonova ON THE RATE OF FOTO-BIOLOGICAL EXOSPERMA IN DROSOPHILA LONGICERAS 1960 p. 5 preprint)

The irradiation of Drosophila spermatic and recessive lethals. Fractional irradiation and the mutagenic effect. The relationship between the results obtained with small doses of neutrons have a mutagenic effect of fast neutrons spermatic and the absence of a threshold. The a
Edington 1988 - [3777]

Erdman 1960 - [867]

Fall, R. STUDIES ON X-RAY-INDUCED VIABILITY MUTATIONS IN THE THIRD CHROMOSOME OF Drosophila melanogaster. Hereditas 41, 1/2 (1955) 559-78.

An isogenic Drosophila stock was irradiated with an x-ray dose of 2000 r. Forty-seven experimental stocks were isolated in such a way that in each only the third irradiated chromosome was left for the study of viability mutations. Hatchability was used as a measure of viability, and thus it was possible to study the effect of the mutations in the homoyzogous as well as the heterozygous flies. The lethal and part of the subvital mutations only were left for the viability test. Of the tested experimental stocks, 79% were affected in their viability. Among these the subvitals occurred about 3.5 times more frequently than the lethals. Among the subvital mutations, those less affected occurred more frequently. In about 1/3 of the completely lethal effect the 3.5 was partially or completely dominant. (auth.)


Subvital mutations were induced in an isogenic stock of Drosophila by 2000 r of x-rays. Third chromosomal mutations only were studied. Among the stocks tested the subvitals were about 3.5 times more abundant than the lethals. 79% of the tested chromosomes carried lethal or subvital mutations. The mutations with the lesser detrimental effect were the more frequent ones. In at least 1/3 of the mutations the effect was partially or completely dominant. The theoretical expectation that the more detrimental mutations are the less dominant ones could only be confirmed in part.

Fritz-Niggli 1956 - [823]


1. Облучение γ-лучами в дозе 5 р спермии и сперматида у дрозофил индуцирует появление резцессивных летальных мутаций. Фракционированное облучение дозой в 20 р и по 5 р за 20 мин приводит к полным генетическим изменениям между спермами облучения сопровождается комбинацией резцессивного эффекта. Относительные частоты (на 1 р) резцессивных летальных, мутаций сперматидах и спермиих облучениях дозами по 5 р, соответствуют данным, полученным другими исследователями при дозированным облучении более высокими дозами. 2. Однако, малые дозы умеренной радиации дают в 1 и 2 раза более резцессивный эффект, чем γ-лучи. 3. Сперматидах, при облучении, при использовании малых доз радиации были примерно в два раза генетически предпочтительнее для облучения как γ-лучами, так и x-лучами. 4. Данные описываются при использовании малых доз вплоть до 5 р указывают на отсутствие порога для резцессивного мутагенного эффекта, он не существует в диапазоне более высоких доз. Если пороговые дозы для облучения существуют, то они будут характерны лишь для данного вида радиации, для определенных типов мутаций и при воздействии на определенную отдельную генетическую конкретного вида организмов.


Irradiation of Drosophila sperm and spermatids by a 5 r-dose of γ-rays gives rise to the formation of recessive lethals. Fractional irradiation with a dose of 5 r, given 5 r at a time at 1 h-intervals, induces all the mutagenic effect. The relative rate of recessive lethals per r induced in sperm by fractional doses of 5 r corresponds to the results obtained by other workers with higher single doses. Equal small doses of fast neutrons have a mutagenic effect 1.5-2 times higher than that of γ-rays. At small doses of either γ-rays or fast neutrons spermatids prove twice as mutable as sperm. Results from small doses up to 5 r point to the absence of a threshold. The absence of threshold values must be borne in mind. If threshold doses should
eventually be found they will be characteristic only for the particular radiation, the particular mutations and the particular stage in gametogenesis of that one species.

Evidence is presented that x-rays and y-rays can induce back mutations which, according to current criteria, do not differ from spontaneous mutations. D. females mutagens homologous for one or the other forked pseudoalleles, FM and F', both known to back-mutate spontaneously, were irradiated. A comparison of the induced and spontaneous rates of reversals shows that 4000 r x-rays increased F' reversals 7 fold, whereas equivalent y-irradiation somewhat more than tripled the reversal frequency. Back mutations of F' were significantly increased; those of F' apparently not. The back mutations are not associated with detectable chromosome alterations.

(For details see ref. 996)

L'étude des mutations fatales récessives, liées au sexe chez D. melanogaster montre que le pourcentage des mutations spontanées apparaissant dans la souche utilisée s'élève à 0.0081%, des doses de rayons X aussi faibles que 40 r ou 20 r peuvent augmenter de façon appreciable le taux de mutabilité (respectivement à 0.3078% et 0.1919%). Les mêmes quantités totales de rayonnement, fractionnées en doses partielles de 1 r sont encore efficaces; le fractionnement de la dose a pour conséquence la diminution relative du pourcentage des mutations induites par l'irradiation (0.1944% au lieu de 0.3078%). Il semble que le raccourcissement des intervalles entre les expositions partielles conduise à une augmentation progressive du taux des mutations, qui tend vers celui obtenu après irradiation continue. (aut.)

The translocation induced by chromosome irradiation is probably a reciprocal interchange involving the W chromosome and a Zebra-larva autosome, where a W chromosome segment bearing the female-determining factor is combined with a segment bearing the Zebra gene, while the rest of the W chromosome is united with the part of the autosome bearing the lemon locus. The lemon locus-bearing segment apparently carries the lethal factor in question. In ordinary circumstances the W chromosome is transmitted in the female line, but when the segment enters a male as in the present case, it produces a lethal effect. Therefore, it may be concluded that the W chromosome has a regional differentiation, and the female-determinating factor occupies a certain restricted region of the chromosome, while the other region has a lethal effect for the male which carries it. (aut.)

998 Heidenhaut, G. X-RAY INDUCED RECESSIVE LETHALS IN HAROBROCHON. Genetics 97 (1956) 590.
A method for detecting x-ray induced recessive lethals has been developed as follows: Virgin females which have been forced to store 1st meiotic metaphase eggs were irradiated and then outcrossed to haploid males. F1 virgin which developed only from eggs x-rayed in 1st metaphase were then tested by allowing each to carry eggs. These were counted and later examined for hatchability. Control hatchability for comparable F1 was well above 90%, for no female was it as low as 50%. In the experimental series, any F1 which laid eggs 50% or fewer of which hatched, was tallied as bearing one or more recessive lethals. The eggs counted were haploid; therefore, a recessive lethal on any chromosome, which would act prior to hatching of larva, would give approximately a 1:1 ratio of dead eggs to live larvae; those bearing two independently assorting lethals a ratio of 3 dead eggs to 1 live larvae etc. The data thus far indicate a ratio for one or more lethals of approximately 5.1% for 500 r and 14.2% for 1000 r. Comparable data for recessive lethals induced in sperm give also been shown to be applicable.

(abstract of paper presented at Symposium)

999 Heidenhaut, G. A COMPARISON OF MEiotic METAPHASE EGGS FOR DIFFERENT SPECIES. Methods have been developed for irradiation of metaphases of Drosophila melanogaster which permitted the assessment of the dominant lethal curve and the 99% at about 1000 r, the average of 30 to 1000 r. The phase eggs were found to be more sensitive than the meiotic and recessive lethal assays.

Henke, K., Pohl, H.-J. BILDUNG DER MEHLMOTTE EINE ZELLE. Neues Arch. exp. Path. Pharmakol. 254 (1967) 11-20. The cell of the rudimentary body is a meristematic cell; it divides in a differentiation of its own, and the appearance of such mutant eggs is somewhere between the last larval instar and pupation.

Henekwitz and Abrahamson 1959-1963

Henekwitz and Schaet 1957

Hennikowitz, L.H., Baumlser, M. MUTATIONS IN DROSOPHILA. Heterozygous mutations produced under nutritional stress and kill approximately 1/2 of the offspring; no effects are detectable in the present experiment, partly by different types of selection.

Henekwitz et al. 1959 - 1265

Höhrle and Schubert 1954 - 1897

Höhrle et al. 1955 - 1389

Höhrle et al. 1956 - 1389

Ives, P. T. RADIATION INDUCED LETHAL MUTATIONS IN DROSOPHILA. Genetics 97 (1956) 591-94.
A comparison is made of radiations to the testis of the male for the effect on the frequency of recessive lethals induced in the females for the effect on the frequency of recessive lethals induced in the females. The results show that the frequency of recessive lethals induced in the females is not affected by the radiation to the testis of the male, but that the frequency of recessive lethals induced in the males is increased by the radiation to the testis of the male.

The fast neutron of an atomic bomb is used to induce mutations in D. melanogaster. The fast neutron of an atomic bomb is used to induce mutations in D. melanogaster. The fast neutron of an atomic bomb is used to induce mutations in D. melanogaster. The fast neutron of an atomic bomb is used to induce mutations in D. melanogaster.
lethals induced in sperm give 5.0% and 10.7% for the same dosages respectively. The above method has also been shown to be applicable to the much more resistant prophase stage.

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


Methods have been developed for estimating x-ray induced dominant and recessive lethals. Natural parthenogenesis has permitted study of rates for the entire chromosomal complement. For the metaphase eggs the dominant lethal curve is a simple exponential function with the 50% lethal point at about 273 r and the 90% at about 1850 r. The dominant lethal curve for the sperm is markedly different. The metaphase eggs were found to be more radiosensitive than the sperm. The effect of dose rate on induction of dominant and recessive lethal fraction is discussed. (from abstr.)

1000 Henke, K., Pohley, H. T. DIFFERENTIELLE ZELLTEILUNGEN UND POLYPLOIDIE DER SCHWANEBILDUNG DER MEHLMOTTE ESPESTA KIHNELLA Z. (Differential cell divisions and polyploidy in the scale formation of the flour moth Euspessa kihinella Z.). Z. Naturforsch. 11, 2 (1956) 65-78. (In German)

The cells of the rudimentary hind wings of Euspessa pass through 5 to 6, as previously supposed -- differential stage of cell division in the course of the mitoses of the prepupal and pupal period. A somatic mutation in the form of dark scales is often observed at the result of irradiation. The frequency of appearance of such mutant aggregates and their dependence on the moment of irradiation which is fixed somewhere between the last larval molt and before the onset of the prepupal mitotic period is discussed.

a Henkowitz and Abrahamson 1955 - [1193]

b Henkowitz 1956 - [1192]

c Henkowitz and Schallet 1957 - [1196]


Heterozygous mutations produced by 3000 r delay pupation in about 9% of larvae of Drosophila melanogaster under nutritional stress and kill approximately 6%. The effects are less, though appreciable, when there is excess nutrient; no effects are detectable after oogenesis is irradiated. Irradiated sperm and oocytes cause detritus, partly via different types of mutations, in approximately equal amounts. (auth.)

a Henkowitz et al. 1959 - [1202]

b Höhne and Schubert 1954 - [834]

c Höhne et al. 1955 - [1389]


A comparison is made of radiation-induced mutation rates in Drosophila melanogaster and mice by considering primarily the data of Russell (Symp. Quant. Biol. 16 (1951) 327-36), Alexander (Proc. Gen. Soc. Amer. 11 (1953) 7) and the author. It is argued that the comparison should be made on the basis of f results using only autosomal loci. Considering also the extremely non-randomness of the mutation rates of the few autosomal loci so far studied it is concluded that for the present the radiation-induced mutation rate per r per locus appears to be similar in flies and mice.


The fast neutrons of an atomic explosion were three to four times as effective as x-rays in producing sex-linked lethal and autosomal visible mutations in the mature sperm of Drosophila melanogaster. About 40% of the sex-linked lethal chromosomes gave evidence of containing gross chromosomal aberrations, eight times as
many as appeared in a group of mutator-caused lethals. The increase in mutation rate with increasing dosage of fast neutrons appeared to be linear for sex-linked lethals, both with and without gross chromosomal aberrations, but the rate may not have been linear in the case of the autosomal visible. (auth. summary)

Ives, P. T. THE MUTATION RATE IN DROSOPHILA SPERM AFTER COBALT-60 γ-RADIATION.


Spermatocytes from 24-old mated Oregon-R males were tested by Basc after exposure to Co^{60} γ in doses ranging from 300 r to 12,500 r in intervals of 700 r to 3500 r. For each of 7 doses a maximum of 1200 X-chromosomes was tested and a minimum of 110 lethals chromosomes was observed. Plotted directly the data fit a straight line with a slope of 1.8% lethal chromosomes per 1000 r. Individual mutational events probably occurred at a greater than linear rate of increase with increase in dose. Tests with 438 lethal chromosomes from 300 r showed only 2 instances of separable lethal genes and 23 cases with reduced crossing-over with which 9 were translocations and 14 inversions. These results are comparable to those in a previously published study of lethals produced by a genetic mutator except that in that study all of the 13 analysed cases of reduced crossing-over were inversions. (from strab.)

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

Mature sperm of Drosophila melanogaster were subjected to γ radiation from a Co^{60} source. Tests were made of the frequency of easily seen visible mutations, chiefly autosome dominants, induced at ten radiation dosage levels in the 0.5 to 10 kr range. Results are related to findings in sex-linked lethal tests.


Three series of X-chromosome lethal mutations, from the mutator bi, from 300 r and from 12.5 kr of cobalt-60 γ radiation were analyzed for distribution of lethal loci, chiefly with respect to the four regions set off by the marker genes. The distributions are compared to each other and to proportions of available genetic material in each region. The difference between mutator and radiation lethal loci distribution is consistent with the hypothesis that mutator genes are genetically more specific, ionizing radiations more general, in their mutagenic effects. It is suggested that series of spontaneous lethals from strains of D. melanogaster derived recently from different geographic areas may be expected sometimes to show different chromosomal distributions but that series of lethals induced in each strain by a given radiation treatment should be generally alike. (from auth.)


Data are presented from a study of the sex-linked mutation rate in mature sperm of Drosophila melanogaster at seven dosage levels of Co^{60} γ radiation in the 300 r to 12.5 kr range. Lethal chromosomes from the lowest and highest doses were analyzed genetically, and the results are compatible with the interpretation that a Poisson-like accumulation of lethal mutations occurred throughout this dosage range, with an average increase of 4% lethal mutations per kr. (auth.)


A comparison of x-ray-induced mutations in the x- and in the second-chromosome in sperm was made. It was found that in both types of chromosomes slightly higher rates of recessive lethals were induced than of strong detrimental.

Kaplan and Lyon 1953 - [1951] 1008

Kayhart 1954 - [830]

Kayhart 1956 - [836] 1012

King, R. C., Wood, E. M. SEX IN DROSOPHILA MELANOGASTER. Genetics 100 (1959) 967-78.

Sex-linked recessive lethals, analgaster, were treated with Co^{60} γ radiation. In all cases which reach a value only with a small frequency is taken to represent the class of chromosome a reduced for the first four days. After a week has passed the male number of females contains 60%. The rise in productivity of the male laid at this time were 16-cell stage and are laid in a polypliotic same fashion as is polypliotic.

King 1955 - [89]


The x-ray-induced recessive lethals on X chromosomes are most activated, phosphorus-Bialda-induced recessive lethal mutations. The in tissue by the two classes of experimental and calculated by P^N-labeled Drosophila melanogaster.

(See also BNL-1849, Brookhaven National Laboratory.)

King, R. C., Wood, E. M. MALE AND FEMALE DROSOPHILA MELANOGASTER.

The recessive lethal mutations are tested for highest dosage tested (8.5 to 10^4 r) up to 3.5 to 10^5 r/cm^2. The number of 1500 r and tested. Lethal rate for sperm. To explain it is assumed that either the number that a large fraction of the possible combinations. On the basis of this it was found to be 2.8 times as effective as sperm and 1.8 times as effective as females is not related to the highest mutation effect on the action of this radiation nitrogen content of the Drosophila.

King, R. C., Wood, E. M. SEX IN DROSOPHILA MELANOGASTER. Genetics 100 (1959) 967-78.

Germline tissue of D. melanogaster is primarily responsible for the biological effect of x-rays as effective in producing sex-linked lethals. The mutation rate detected in viable eggs laid 5 to 8 and 8 to 10 days after the original rate is only 70% the rate while the female egg line may be due to late stages of gametogenesis or fertility in the female generally but not in the early meiotic stages from 0.9 to 1.1.

Sex-linked recessive lethals were recovered from successive batches of eggs laid by female Drosophila melanogaster irradiated with 4000 r of X-rays. While the initial frequency of lethals (10%) is similar to that of males treated in an identical manner, there is an immediate linear decline in lethal frequency which reaches a value only 60% the initial frequency in eggs laid 7-12 d after irradiation. The decline in frequency is taken to represent the elimination in immature germ cells of induced lethal effects belonging to the class of chromosome aberrations. The fecundity and fertility of irradiated females is greatly reduced for the first four days after treatment. As risk 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% as many sex-linked lethals as the eggs produced immediately after irradiation. The 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 polyplody. (auth. summary)

King 1953 - [899]


The X-ray-induced recessive lethal mutation rate in D. melanogaster has been found to be the same whether or not X chromosomes are modified by the attachment of fragments of the Y chromosome. X-rays from neutron-activated, phosphorus-bakelite plaques are found to be 60% as efficient as 90 kV X-rays in producing sex-linked recessive lethal mutations. This difference is attributed to differences in the distribution of ionization produced in tissue by the two classes of radiation. Recalculation of earlier data leads to the conclusion that the experimental and calculated values for the fraction of the total ϕ absorbed dose of 5524 particle energy absorbed by the gonad of male Drosophila are not in disagreement as was previously thought. (auth. summary)

(See also BLN-1849, Brookhaven National Lab., Upton, N.Y. 1954, 21p.)


The recessive lethal mutation rate/thermal neutron dose relation appears to be linear for sperms up to the highest dosage tested (4.6 × 10^12 N/cm^2). The relation is also linear for oocytes and oogonia for doses up to 3.5 × 10^12 N/cm^2. The average mutation rate per unit dose for oocytes is 75% the male rate, for oogonia 98% the male rate. The mutation rate in the most mature egg cells appears to be similar to the rate for sperms. To explain the lower frequency of mutations recovered from oogonia than from oocytes it is assumed that either the mutation process occurs at a lower frequency in oogonia than in oocytes, or that a large fraction of the potential recessive lethal mutants are drawn off into inviable chromosome re-combinations. On the basis of energy liberated per unit weight of gonadal tissue, thermal neutrons are found to be 2.5 times as effective as 90 kV X-rays in inducing sex-linked recessive lethal mutations in sperms and 1.8 times as effective in inducing mutations in oocytes and oogonia. This greater efficiency is not related to the higher mean ionization density of the nitrogen capture protons which form the physical basis of the action of this radiation. More likely the increased efficiency is due to a greater than average nitrogen content for the Drosophila gonad. (from abstr.)


Germline tissue of D. melanogaster males and females was used. Nitrogen capture protons (which are primarily responsible for the biologic effects of thermal neutrons in the fruit fly) are approx. 1.5 times as effective in producing sex-linked lethal mutations in sperms as 90 kV X-rays. Over the range of doses used the lethal mutation rate/dose relation for X chromosomes of sperms appears to be linear. The mutation rate detected in viable eggs laid following treatment remains fairly constant for the first 6 d. Eggs laid 6-8 and 8-10 d following exposure have mutation rates 70% and 50% of the original value. This original rate is only 75% the rate for spers. The difference in the mutation rates induced in the male and female germ line may be due to a difference in mutability between sperm and egg chromosones treated in late stages of gametogenesis or to differences in the nitrogen concentration between the male and the female gonad. In the female germ line the lower frequency of mutations recovered from premeiotic and early meiotic stages than from late meiotic stages may that the mutation process occurs at a lower
frequency in less mature cells or that a larger fraction of the potential lethal mutations are drawn off into inviable chromosome recombinations. Exposure of males and females to thermal neutrons also produces cost and fragmentation of chromosomes in germ cells. (auth.)

(Earlier work was published under the same title as BNL-1778, Brookhaven National Lab., Upton, N. Y., 1955, 28 p.)

1013 King, R.C. DOMINANT LETHAL MUTATION AND X-CHROMOSOME ELIMINATION AFTER X-IRRADIATION OF FEMALE DROSOPHILA MELANOGASTER. Radiation Res. 3 (1955) 149-52; see also Radiation Res. 3 (1955) 335, abstr 81.

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

* King (undated) - [1145]

1014 King, R.C., Darrow, J.R., Weber Kaye, N. STUDIES ON DIFFERENT CLASSES OF MUTATIONS INDUCED BY RADIATION OF DROSOPHILA MELANOGASTER FEMALES. Genetics 41 (1956) 890-900.

The sensitivity of the germ cells in Drosophila melanogaster to radiation-induced chromosome breakage (measured by dominant lethality and X-chromosome loss) varies strikingly during oogenesis. Exposure to 0000 r of γ-rays from a Co-60 source was used, delivered in 40 s. Many dominant lethals were induced in old oocytes, a few in young oocytes and none in oogonia. The damage to X-chromosomes showed a similar gradation. Recessive lethal mutations were induced in all three stages. Chromosome diakinesis and metaphase I are extremely sensitive, those in diplotene moderately sensitive, and those in pachytene stages relatively insensitive to radiation-induced breakage.

See also research report BNL-2565, Brookhaven National Lab., Upton, N. Y.


In D. melanogaster sensitivity to radiation-induced mutation varies strikingly during the development of the egg, and ovarial oocytes may be subdivided into three categories. Cells of Class A show a high rate of dominant lethal mutation and of X-chromosome loss and recessive lethal mutation; whereas cells of Class B show lower rates of all three types of mutation. The difference in sensitivity to mutation is not the result of germinal selection, and it can be correlated with cytogentic differences between the two groups of cells (although both are in diplotene). In group A cells the nuclear membrane has broken down and the chromosomes are maximally condensed; whereas the diffusely chromatin of group B cells lie in a typical nucleus. Cells of Class C (which include those which are in per-diplotene stages of meiotic prophase as well as oogonia) contain few or no induced dominant lethal mutations and X-chromosome losses; but the frequency of sex-linked recessive lethal mutations is not significantly different from that found in cells of Class B. Perhaps the probability of breakage is low or the probability of restitution high in chromosomes of Class C cells. If such were the case, dominant lethal mutations and X-chromosome losses would not be produced, but subtler types of genetic change such as recessive lethals would still occur. Since the latter type of mutation is not eliminated from the germ tract it is this class of mutations which should be studied in populations of higher animals exposed to radiation.
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Gene National Lab., Upton, N. Y.

OME ELIMINATION AFTER
ation Sci. 2 (1955) 145-52;

some losses found in eggs laid at

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time of treatment. No significant
male flies, which indicates that
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subsequently declines. The re-
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rate of sex-linked recessive lethals
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nt lethal mutations. (auth.)

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X-chromosomes showed a similar

hromosome diakinesis and meta-
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Y.

PHILA MELANOCASTER (abstr.)
ny, Montreal 17-29 Aug. 1956.

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Cells of Class A show a high rate of
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60 newly eclosed sf of a Texas strain were given 2800 r x-rays and mated with untreated $\psi$. Neither $F_1$ (200 animals) nor $F_2$ (50 000 adults) showed any visible mutations; only $F_2$ (150 000 adults) showed 91 variant forms among 76 $F_2$-brother-sister-matings; 7 mutations are described in some detail. Mutations in natural populations are extremely rare. The gene content appears, however, to be relatively vulnerable to x-rays in certain positions as revealed by a mutation rate of at least 9%.

1017 LaChance E. I. INDEPENDENCE OF INERT MODAL LETHALS INDUCED BY

X-RAYS IN FIRST MEIOCYClical METAPHASE EGGS OF HABROBRACON. Genetics 45 (1959) 655-8.

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

1018 Laven, H. STRAHLENDUZGTE MUTATIONEN BEI Culex Pipiens I. (Radiation-induced mutations in


 Differences in the mutation frequencies of different species of Culex pipiens were interpreted in terms of plasmoid heredity. To show that this phenomenon was not due to a chromosome mechanism which deviates from the normal fertilization and nuclear division, 4 mutations which occurred after subjecting 2-3-old males to x-rays (4000 r) were studied. Since the mutations studied followed the same course of heredity, whether in plasma of their own or other species, the interpretation postulated appears to be correct.

(Translated from Berichte der gesamten Biologie. A. 100 (1956) 345)


A queen bee ordinarily lays fertilized eggs in worker (female) comb cells and unfertilized eggs in larger drone (male) cells. In these experiments queens were inseminated with sperm from unrelated males treated with gamma radiation from Co$^{60}$. The viability of the eggs in worker cells decreased with increasing dose until at 10 000 r virtually no eggs hatched, indicating that almost every sperm carried at least one dominant lethal. However, when the dosage was further increased to beyond 35 000 r the eggs began to develop normally. This must be the result of sperm inactivation since the eggs, even though in worker cells, developed into males. Therefore the sperm inactivation dose is several fold higher than the 100% dominant lethal dose, as in Habrobracon. Nearly all the lethals caused death in the egg stage. There was no significant fractionation effect, the percentage of dominant lethals being the same when 2000 r was given in a continuous dose as when given in two fractions separated by 1 or 4 h. The proportion of lethals in sperm did not change after one year of storage in the spermaticca of the queen. The curve relating dominant lethals to dose is in quantitative agreement with those of Drosophila and Habrobracon. It shows a highly significant departure from linearity (after correction for natural mortality and saturation), but approaches linearity at low doses. This is consistent with the hypothesis that dominant lethals are due primarily to single chromosome breaks at low doses and multiple break phenomena at higher doses.


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

Lee, W. R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. TID-8577, Durham Uni-


An improved technique for partial-body irradiation of bees is described. The parental queen is placed in a block of lead with the last two visible segments of the abdomen extending into a 50 kV x-ray beam. The technique enables comparison to be made between control and irradiated groups, all of which were progeny of the same queen and haploid male. Experimental irradiations using this technique to study viability of mutations are described. Some results of the study are reported, but data are insufficient to make conclusions. The technique is very successful. (NSA 15: 1261, 1961)

Lefevre, G., Jr. X-RAY INDUCED GENETIC EFFECTS IN GERMINAL AND SOMATIC TISSUE OF DROSOPHILA MELANOGASTER. (abstr.) Genetics 55 (1960) 120.

The rate of x-ray induced direct mutation was compared following irradiation of germinal and somatic tissue. Serious question is thrown on the reliability of early reports of x-ray induced reverse mutation in Drosophila. A comparison of the published data regarding the influence of various intrinsic and extrinsic factors on x-ray induced and spontaneous mutation suggests that the two mutation processes are qualitatively different.

(This paper was published more fully in Amer. Nat. 84 (1950) 341-63, see ref. 1029.)


Attempts were made to induce reverse mutations in both germinal and somatic tissue of Drosophila melanogaster. No evidence of reverse germinal mutation was found following irradiation with 5000 r of some 168000 recessive X-chromosome loci. In the somatic studies no reverse mutations of white were found in tests equivalent to the exposure of 60000 white loci to 5000 r. White alleles of three divergent origins were used: (A) spontaneous, (B) x-ray-induced, and (C) mustard-x-ray-induced. The reliability of the early reports of x-ray induced reverse mutation in Drosophila are seriously questioned on the basis of the results obtained. The conclusion was also reached that x-ray induced mutability of the w+ locus is not significantly affected by the kind of cell in which it is located. A comparison of the influence of various intrinsic and extrinsic factors on x-ray induced and spontaneous mutation indicates that the two mutation processes are qualitatively different. In all likelihood mutations induced by ionizing radiation in Drosophila, as in man, are losses or destructions of genetic material, and unlike spontaneous mutations, induced mutations are incapable of further change. 50 references. (NSA 4: 6026, 1950)


A method has been devised that allows the detection and recovery of sex-linked recessive lethals whose lethal phenotype is suppressed by the Y chromosome, as well as checkpoint lethals that are inviable with or without a Y. With doses of 3 and 4 kR, ca. 90% of all induced sex-linked recessive lethals survive in the presence of a Y chromosome, and are consequently overlooked by currently used methods of lethal detection. The continuity of the X chromosome is postulated to play an important role in normal spermiogenesis, this continuity being disrupted by reciprocal translocations. (from aut. summary)

(This report was previously published as a USA report received by UN Scientific Committee on the Effects of Atomic Radiation. A/AC. 82/G/4, 431, 44 p)

Löbbecke, E. A., Müller, L. ÜBER DIE AUSLOßUNG VON SOMATISCHEN MUTATIONEN BEI EPHESTIA KÜHNELLA Z. DURCH WEICHEN UND MITTELHARTE RÖNTGENSTRASSEN (10-100 kV) (On the induction by soft and medium-hard x-rays (10-100 kV) of somatic mutations in Ephesia kuhneli Z.) Z. Indukt. Abstamm.-VererbL Lehre 90 (1909) 421-7. (In German)

Developing Mediterranean flour moths (Ephesia) were exposed to x-rays of 10 kV up to 100 kV and certain changes in the pattern of the winglets of grown up animals were interpreted to constitute somatic mutations. The series of tests were carried out at three different times and resulted in fluctuations which were so strong that there was no distinct correlation between the frequency of somatic mutations on the one hand and the type of radiation on the other.

1026 Löbbecke, E. A., Müller, L., KÜHNELLA Z. BEI VECHI-

1027 Lüning, K. G. STUDIES ON THE EFFECTS OF PHOTOPHOSPHORUS ON DROSOPHILA MELANOGASTER. (1950).

* Lüning 1950 - [1208]


A high rate of hyperploid mutations at high rate of dominant lethal might then have to be supposed. x-ray-induced spermatids by a check observed in the rate of gynogenesis, proposed; breaks leading to parameter movements of the chromosomes independent of breaks leading to sex-chromosomes.


The paper deals with x-ray induced stages of spermatogenesis of Drosophila which are distributed in the female. The breakage is a peculiarity of the male and the number of mutations are not only due to this in a slight extent (if at all) subject to a discussion.

Lüning, K. G., Lindell, B., DOMINANT LEThALS IN DROSOPHILA MELANOGASTER. By means of a discharge room x-ray irradiation. Drosophila males with high egg-laying capacity. Maximal low intensity irradiation was 5 microseconds and the low intensity.

* Lüning 1950 - [1208]
The parental queen is placed in a box for 15 minutes into a 50 kV x-ray beam. The treated groups, all of which were progeny of the same queen, were injected with a dose of 5000 r of some of various intrinsic and extrinsic factors. The results are summarised below.


A high rate of hyperploid males was obtained from treated spermatozoa. From this it would appear that the high rate of dominant lethals in the same period is partly due to more asymmetrical interchanges. One might then have to suppose a higher rate of breaks in mature spermatozoa. As many breaks are apparently induced in spermatozoa by a dose of 960 r than by 800-4000 r in mature spermatozoa. No increase was observed in the rate of gynandromorphs with an increase in the rate of hyperploid males. A hypothesis is proposed; breaks leading to gynandromorphs are induced as potential breaks which are not separable by movements of the chromosomes, but which break up in the next chromosome division. Thus, they are independent of breaks leading to dominant lethals.


The paper deals with x-ray induced apparent gene mutations (invisibles and recessive lethals) in various stages of spermatogenesis of D. melanogaster. Details of methods and results are given. It is shown that the breaks are distributed in a similar manner for all stages of spermatogenesis and thus that the differential breakability is a peculiarity of material along the whole chromosome. It is concluded that apparent gene mutations are not only due to intragenic changes but also to intergenic changes, and that the latter are only slightly (if at all) subject to variations between different stages of spermatogenesis. A considerable section is devoted to discussion.


By means of a discharge roentgen tube, the authors have tested the biologic effectiveness of high-intensity radiation. Drosophila males were irradiated with 600 to 900 r and after 7 d, mated to selected females of high egg-laying capacity. No significant difference in hatchability could be seen when high as compared to low intensity radiation was used, though the high intensity produced the irradiation dose within only 50 microseconds and the low intensity dose was given over 15 min. (auth.)


The results indicate that the rates of determinals induced in sperm chromosomes vary with the stage.
treated in a manner similar to that shown for viables and recessive lethals. The proportion of weak detrimental appearances were at least 5 times as high as the proportion of strong detrimental or recessive lethals, which are similar to one another. In the female irradiation series the results have not contradicted the earlier observations that recessive lethals induced in unfertilized eggs appear at a slightly lower rate than in sperm, used the first 3 d after irradiation. Further, the relation between the rates of recessive lethals and "strong" detrimental are not different from that observed in the male irradiation series. It is a remarkable fact that "weak" detrimental are so rare in the female irradiation series.

* - Lining and Hendriksen 1950 - [1280]


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

(aut. concl.)


Female wasps were picked at random from normal wild-type population. Among progeny of exposed females there were an avg. of 286 abnormal individuals as compared with 1-2% in controls. Abnormalities were most common in the wings. Some of the evidence indicates that X-ray may produce sterility and mutations as well as increase of atypical genotypes. Such evidence should be taken into account in the use of X-ray for treatment of human disorders. (BA 26: 2692, 1953)


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

* Mickey 1954 - [839]

* Mickey and Vanders 1954 - [840]

1036 Montage, J. SPERM UTILIZATION AND BROOD PATTERNS IN Protophila MELANOGASTER. Amer. Nat. 59 (1925) 123-7.

It is found that Protophila males will fertilize as many as 10 virgin females per day and that, in order to achieve maximum utilization of sperm, it is necessary to mate males with large numbers of virgin females daily. It is demonstrated that mature sperm are retained in the testis at least a few days. When newly emerged males are irradiated with 3500 r and mated according to the above system, there is a decided decrease in mating activity and an increase in dominant lethals on the 8th to 9th day after irradiation.

(sup. summary)

* Montage 1956 - [841]

* Montage 1956 - [303]

* Montage and O'neal 1958 - [1043]

* Muller et al. 1950 - [1211]

1039 Muller, H.J. ADVANCES IN UN International Conference Review article. The author reviews the frequency-dose relation and the spontaneous rate of the different cell types. A systematic rate and the spontaneous rate of these phenomena in interpretation are considered.


The frequency of translocations varies linearly with dose even in those that broken chromosome ends can be repaired by the same track to occur. Thus the pieces would usually be of equal length. From this it can be inferred that in this material the translocations seldom accompany other rearrangements, and that even when there is no cytokinesis in close proximity (whether in the result of the crowding of individuals remainst closely localized.

(See Rec. Genet. Soc. Amer. 1947)


The production of gene and chromosome changes is reviewed. The results of consideration, neucleus as observed as x-rays in their production stage that of x-rays, would rise under the production of translocations.

* Muller 1954 - [843]
The proportion of weak detri-
lential or recessive lethals, results have not contradicted the
appear at a slightly lower rate than
been the rates of recessive lethals
male irradiation series. It is a

1036 Muller, H.J., Valencia, J.L. THE LOCALIZATION OF THE MUTAGENIC ACTION OF NEUTRON-
INDUCED IONIZATIONS IN DROSOPHILA. (abstr.) Genetics 36 (1951) 567-8.
The frequency of translocations induced by fast neutron irradiation of Drosophila melanogaster was found to
vary linearly with dose even at doses sufficient to produce multiple proton tracks per sperm. This shows
that broken chromosome ends derived from different breaks caused by the same track undergo recombination
with one another much oftener than with those of different tracks. Our interpretation is that breaks caused
by the same track tend to occur near together, this proximity favoring union between the broken ends.
Thus the pieces would usually unite before greatly changing their relative positions. It must further be
inferred that in this material a break usually occurs close to the point of origin of the ionization that
induces it, i.e., that remote breakage effects, resulting from migration of ionisation-induced, relatively
stable mutagens over microscopically appreciable distances, are uncommon. Further evidence for this
conclusion is provided by the finding that loci, like that for white eyes, which with x-rays give "visible
mutations" seldom accompanied by a lethal effect unless there is a microscopically visible deficiency or
other rearrangement, give with neutrons "visible mutations" that are usually accompanied by a lethal effect,
even when there is no cytologically demonstrable alteration. This concatenation of two mutagenic effects in
close proximity (whether in these cases usually breaks or gene mutations or both is not yet decided) would
result from the crowding of ionizations in proton tracks, provided the mutagenic action of the ionizations
remained narrowly localized.

(See Rec. Genet. Soc. Amer. 20 (1951) 115-6)

1037 Muller, H.J. THE RELATION OF NEUTRON DOSE TO CHROMOSOME CHANGES AND POINT MUTATIONS
The production of gene and chromosome changes by the application of fast neutrons to Drosophila spem-
atorosa is reviewed. Comparable series of experiments with x-rays are also considered. The results and
their interpretation are discussed. At a level of doses yielding a 10% frequency of the translocations under
consideration, neutrons as observed under the experimental conditions described are 2.5 times as efficient
as x-rays in their production of translocations; with lower doses their efficiency in this respect, relative to
that of x-rays, would rise until that very low level of dosage was reached below which, according to theory,
the production of translocations by x-rays also became linear.

* Muller 1954 - [543]

1038 Muller, H.J., Henikowits, L.H., Abrahamson, S., Oster, L.I. A NONLINEAR RELATION BETWEEN
From the experimental data obtained, the authors inferred that heterogeneity in susceptibility of the germ
cells at the time of radiation must be taken into account when interpreting results. There is a strong posi-
tive correlation between susceptibility to the chromosome breaking and that to the recessive lethal inducing
effect of x-rays. It is pointed out that heterogeneity of a similar kind probably exists, to a lesser extent,
in the germ cells of a period shortly before ejaculation, when older males are used, and that it may even
be present to some extent in the germ cells of that period in young males. In view of these considerations,
and the fact that in most earlier work the importance of exactly controlling paternal age and germ-cell
stage was not realized, the significance of earlier data purporting to show the continuing linearity of the
lethal frequency-dosage relation at high doses becomes uncertain, and conclusions based on a supposed
linearity in this dosage region should be held in abeyance until more definitive data can be obtained on
material of maximal homogeneity. (from subh, summary)

1039 Muller, H.J. ADVANCES IN RADIATION MUTAGENESIS THROUGH STUDIES ON DROSOPHILA. 2nd
Review article. The author reviews the significance of Drosophila data by various workers. After discussing
the frequency-dose relation at low and moderate doses, the author considers the different susceptibilities of
different cell types. A section is devoted to discussing the relation between the induced point-mutation
rate and the spontaneous rate. Mutational mechanism, the conditions under which they operate, and diffi-
culties in interpretation are considered. 68 refs.

(Also published in Progress in Nuclear Energy, Ser. VI, Biological Sciences 2 (1969) 146-60,
Marati et al. 1957 - [1215]


Summaries are presented on studies on the genetic effects of radiation on populations of Drosophila and yeasts. A discussion is included of methods for the determination of optimum mutation rate and degree of dominance by the principle of minimum genetic load. (NSA 15: 4558, 1961)


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


Genetic effects of irradiated cytoplasm on untreated introduced chromosomes were demonstrated by the appearance of mosaic eggs in the progeny of x-irradiated female silkworms of genotype pe/pe ry, mated to wild-type unirradiated males. Since it was considered that the mutagenic power of irradiated cytoplasm might be fast if the interval between irradiation and fertilization was too long, and in order to shorten the interval between irradiation and egg laying, the females were kept at about 10°C for 12 h. previous to irradiation, and the period within which mating was possible was restricted to 2 or 4 h. (NSA 7: 6335, 1955)


An attempt was made to determine whether mercaptoethylamine (MEA) and cystine protect the silkworm against mutagenic and lethal effects of radiation, using visible mutations (egg colour mutants) and hatchabilities. The wild-type female moths, which received the injection of MEA, cystine or physiological salt solution (control), were irradiated with x-rays and then mated to double recessive pe/pe pe/pe males. In other experiments, eggs from the mating of wild females and w w, males were immersed in MEA solution before irradiation. In either case, the mutation rates were estimated as uncoordinated of marked loci by examining the egg colour. There was no protective action of MEA and cystine against the mutagenic and lethal effects of irradiation in these experiments. (abstract, summary)


An attempt is made to compare the pattern of x-ray induced mutation rates at two loci (pe and ry) along the same chromosome (V). Both control egg and eye colour. The results are tabulated. The total mutation rates increased more rapidly following irradiation of females than of males. The results of some unpublished work by Y. Tazima are quoted who irradiated pupae and larvae. The total mutation rates produced by the same dose of x-rays at both loci were higher after female than after male treatment; the ratio of mutation rates at the pe - and the ry locus proved > 1 (2 to 5) after treatment of males, and < 1 after treatment of females.

Nakao 1987 - [1403]

Nakao 1988 - [1213]


Dose-effect curves for the two radiations were established for bristle damage induced in the 5-h-old chrysalid stage of Drosophila. Individual bristles showed variable radiosensitivity and a linear damage curve with increasing dose. The changes induced were interpreted as representing phenoocopies of known mutations, caused by chromosome damage.


Experiments were carried out on spermatogenesis on the first and explanation are discussed in the following paragraph.

Offedal and Moseg 1957 - [1269]

Offedal and Moseg 1958 - [1268]

Offedal 1959 - [1267]

Oster 1955 - [1218]

Oster 1957 - [1219]


The exposure of individuals to lead to an acceleration of occurred when it was found that x-rays than females. Experiments related to scro. This avoided the individuals were exposed to 1200 r: were fairly dry. The males showed in chromosomal morphology, vizualization is shown. The major abnormalities lack of many musculature. Mortality, in the tissues, in the lymphocytes and the male. The reasons for the mortality work and the authors' own fin. (Par.)

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

Experiments were carried out by acute γ-radiation reported. Less conclusive evidence indicating production of ordinary lethals from a Co 60 source, one group abstr.)

Paget 1954 - [1440]

Experiments were carried out in order to study the causes of the dominant lethals carried by spermatozoa on the first and second day following irradiation. The problems involved and their possible explanation are discussed in the light of some experimental data obtained by the authors on Prosopephila.

* Ofstedal and Moseg 1957 - [297]
* Ofstedal and Moseg 1957 - [298]
* Ofstedal 1958 - [385]
* Ofstedal 1959 - [396]
* Oster 1955 - [1217]
* Oster 1956 - [1218]
* Oster 1957 - [1219]


The exposure of individuals to radiation, besides resulting in damage to various organ systems, was found to lead to an acceleration of the so-called "natural" aging processes. A breakthrough on this problem occurred when it was found that male larvae of Prosopephila melanogaster are more susceptible to killing by x-rays than females. Experiments were conducted using hybrid third instar larvae from crosses of two un-related stocks. This avoided the use of individuals already homozygous for deleterious genes. The individuals were exposed to 1200 r (135 kV, 20 mA; 1 mm Al filtration; 160 r/min) when their outer surfaces were fairly dry. The males and females resembled each other genotypically and phenotypically but differed in chromosome morphology. The scheme used to obtain ring- and rod-shaped chromosome-bearing individuals is shown. The majority of the irradiated individuals which reached adulthood showed extreme wing abnormalities, lack of many bristles, and marked weakness which was presumably due to damage to the musculature. Mortality, in those cases in which it occurred during the pre-imaginal stages, occurred most frequently among late pupae and very rarely during the late larval and early pupal instars. These results demonstrate that this x-ray induced life-span shortening has a genetic basis, and that complement data obtained previously concerning the susceptibility to x-ray induced somatic damage of male and female larvae having one and two X chromosomes, respectively. (NSA 14: 24012, 1960)

1048 Oster, W., Müller, H.J. GENETIC BASIS OF SOMATIC DAMAGE PRODUCED BY RADIATION. (abstr.) Science 169, 1386 (1959) 1422-3.

The reasons for the mortality caused by irradiating Prosopephila larvae are discussed, in the light of Oster's work and the author's own findings.


Experiments were carried out to test whether the principle of lower mutagenic effectiveness of chronic than of acute y-radiation reported for mouse oogonia also holds for Prosopephila. This was found to be the case. Less conclusive evidence indicates that the same principle holds in Prosopephila spermatogonia, both for the production of ordinary lethals and of minute deficiencies. The respective dosage applied were 4000 r from a Co60 source, one group of flies getting 11 r/hr for 2 weeks, the other the whole dose in 31 hrs. (from abstr.)

* Paget 1954 - [1446]

1043 CHROMOSOMES OF DROSOPHILA. In AMONG THE CHROMOSOMES OF DROSOPHILA (Orthoptera) have been found variations in the length of individual chromosomes, which were demonstrated by the method of genotype ph/pe, pe/pe, males. The polymorphic variation in the length of the X, Y, and autosomal chromosomes has been observed. This variation suggests the possibility of using these variations as a tool for studying the inheritance of characters. (From a paper by E.O. Hinds, Genetics 34, 1959.)

1044 DROLAMINE AND CYSTEINE TO EFFECTS OF RADIATION. The effects of radiation on the development of Drosophila melanogaster larvae have been studied. It was found that the addition of cysteine to the diet of these larvae increases their resistance to radiation. The mechanism by which cysteine protects the larvae is not yet understood, but it is believed to involve the formation of a protective substance that helps to repair radiation damage. (From a paper by J.A. Salmon, Nature 195, 1951.)

1045 IN VISIBLE X-RAY INDUCED LETHALS the International Genetics Symposium, 1st Council of Japan, 1957, 702 p. rates at two loci (ge and pe) along with data are tabulated. The total number of males was calculated using the methods described by Oster and Muller. The results show that the mutation rate is not significantly different from zero. (From a paper by O. Okazaki, Genetics 33, 1954.)

Pal, R., Krishnamurthy, B. S.  
**INDUCED MUTATIONS OF X-RAY IRRADIATIONS IN CULEX FATIGANS**  

Mutations were induced in *Culex fatigans* by exposure to x-radiation. Four morphological aberrations were observed in the first generation following exposure of normal laboratory-bred pupae. Mosquitoes with only one of the mutations were bred successfully. Details of the F₂ generation are tabulated. (NSA 14: 1380, 1960)  

* Parker 1959 - [1225]  
* Parker and Hammond 1958 - [1224]  
* Parker 1960 - [1226]  

Paul, W., Schubert, G.  
**ÜBER BIOLOGISCHE WIRKUNGEN SCHNELLER ELEKTRONEN EINES 6-MeV BEAM (The biological effects of fast electrons from a 6 MeV betatron).**  
Z. Naturf. 5b, 7 (1950) 399-404. (In German)  

For the majority of the biological reactions to radiation previously investigated, including the killing of *Drosophila* eggs and larvae by radiation, fast electrons are less effective than x-rays (500 kV). In the determination of sex-bound lethal factors induced by radiation in *Drosophila* no difference was found between the 2 qualities of radiation regardless of whether mature or immature sex were exposed. The same applies to the behaviour induced by irradiation of single chromosome fragments in *Drosophila*. The results are discussed with reference to the theory of his.  

Parisley, H. J.  
**UNTERSUCHUNGEN ÜBER DIFFERENTIELLE ZELLTEILUNGEN UND SOMATISCHE MUTATIONEN AM SCHUPPENLEID DER MEHLMOTTE EPhestIA KÜHNELLA Z.**  
(Investigations of differential cell division and somatic mutations in the scales of the Mediterranean flour moth, *Ephestia kühnella* Z.).  

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

Parisley, H. J.  
**ÜBER DIE SOMATISCHE MUTABILITÄT BEI EPHESTIA KÜHNELLA**  
(Investigation of somatic mutability in *Ephestia kühnella*).  
Biol. Zbl. 74 (1955) 474-480. (In German)  

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

Parisley, H. J., Eiser, H.  
**ÜBER DAS VERHALTEN MUTANTER SCHUPPEN AUF DEN HINTERFLÜGELN DER MEHLMOTTE EPHESTIA KÜHNELLA NACH PUPPENBESTRAHLUNGEN**  
(Study on the reaction of mutant scales on the hind wings of the Mediterranean flour moth, *Ephestia kühnella*, following irradiation of pupae).  

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

Ray, D. T.  
**PRODUCTION OF EYE-COLOR MUTATIONS IN MORMONIELLA BY LOW X-RAY DOSIS AND A DOSE-ACTİON CURVE.**  
Genetics 59 (1955) 681.  

Ultimated females x-rayed with doses ranging from 1340 to 5360 r have given bright eye-colour mutant sons in percentages ranging from 0.14 to 6.25. Similar mutants are found less frequently at lower doses. Data are thus far consistent with direct proportionality.  

Ray, D. T., Whiting, R. W.  
**MORMONIELLA, Biol. Bull.**  
X-ray dose-action curve for mutations in *Mormoniella* pupae. An insignificant  
Ray, D. T.  
**X-RAY DORE-**  
NASCiA VITRIFENNES.  
61, p. Ditt. Abts. 13. 10-100  
Mormoniella vitricennis W.  
For the study of dose-action curve and examining their offspring, organisms necessary to reduce eye colour mutations from *Mormoniella* is a dark brown intermediate colour within dosage experiments and 4000 transitory low and high dosage category abstr.)  

Ray-Chaudhuri, S. P., Sarkar,  
**HOPPER GESONIA FUNCTION.**  
476-82.  
Quantitative data on the frequency of grasshoppers were obtained from the first anaphase of meiosis 23 acrocentric chromosome  
Ray-Chaudhuri, S. P., Pyne  
**BRIDGES WITH GAMMA RAYS.**  
FUNCTIONS.  
Science 129  
The frequencies of bridges were beyond the limits of the experiments done in direct paper. Through 2 independent breaks, caused by a single ionization  
Reeve, E. C. R.  
**THE ROOCH CHARACTERISTICS IN DROSOPHILA.**  
Congress on Genetics, Monta  
A method which enables the method was used. By a suitable cross, irradiated third chromosome, using the third chromosomes, A from both the homologous strain and thorax length and the number of crosses, and also on control in  
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A method which enables the method was used. By a suitable cross, irradiated third chromosome, using the third chromosomes, A from both the homologous strain and thorax length and the number of crosses, and also on control in.

X-ray dose-action curves for visible mutations in *Drosophila* are discussed and a curve for eye-colour mutations in *Mormoniella* presented. They were essentially linear, indicating single hits producing the mutations. An insignificant dip at 2600 r was observed in *Mormoniella*.


*Mormoniella vitriigenis* Walker, a chalcidoid wasp parasitic on blowfly pupae is especially suitable for the study of dose-action curves, especially for the low dosages of X-radiation. By irradiating virgin females and examining their offspring (which are all haploid males) it is possible to obtain the large numbers of organisms necessary to reduce the confidence limits of dose-action curves. The numerous X-ray induced eye-colour mutations from wild type present a group of mutants easy to score. The wild-type eye colour of *Mormoniella* is a dark brown. The eye-colour mutations vary from dark red through orange white; the intermediate colours within these limits are tomato, red, scarlet and orange (peach). Twenty-six high-dosage experiments and 49 low-dosage experiments were performed with reference to dose action. Additional low and high dosage experiments were performed with reference to the testing of mutants. (From abstr.)


Quantitative data on the frequency of dicentric bridges with fragments in irradiated meiotic chromosomes of grasshoppers were obtained by direct cytological examination. The dicentric bridges were detected at the first anaphase of meiosis by irradiating the testes of the grasshopper *Gesonia functiferons*, a species with 23 acrocentric chromosomes in the males. (NSA 7: 1041, 1953)


The frequencies of bridges were found to be independent of the intensity of the X-radiation within the limits of the experiments described in this study. These results, coupled with the fact that the frequencies of bridges are in direct proportion to X-ray doses confirm the impression that the bridges originated not through 2 independent breaks in a chromosome but largely from a single break in an unsplittable chromosome, caused by a single ionization track.


A method which enables the mutational variance of several characters to be measured at the same time was used. By a suitable crossing scheme with *Drosophila melanogaster* it is possible to make standard irradiated third chromosomes homozygous in a genetic background identical with the inbred line providing the third chromosomes. A number of such strains have been produced, using an X-ray dosage of 4000 r, and both the homozygous strains and intercrosses between them have been raised under standard conditions. Wing and thorax length and the numbers of stemite and stomatopleural hairs were estimated on these strains and crosses, and also on control strains obtained by the same mating scheme without irradiation. Strains in which third chromosomes from a wild stock were made homozygous in the same inbred genetic background were also studied, to give a standard against which the radiation-induced genetic variance could be compared. The environmental variance in body size among individuals of the same genotype was, on the average, greater for the homozygous strains than for their intercrosses. This suggests that the third-chromosome heterozygosity induced by 4000 r of X-rays was sufficient to increase the environmental stability of the intercrosses over that of the homozygotes. (from auth.)
1064 Saul, G. B., II. THE INDUCTION BY X-RAYS OF RECESSIVE LETHALS IN THE MATU... 447-60.

Mature males of the chalcidoid Hymenoptera Monomorium vittatum (Walker) were treated with x-rays at doses between 668 r and 5112 r and were then mated to virgin females differing from them by an allele at a single locus. A statistically significant deviation from a 1:1 ratio of the alleles in the F1 progeny of an unmated F1 female was taken to indicate the presence of a recessive lethal linked to the genetic marker. The numbers of lethals linked to two separate loci were computed for each dose administered. No evidence was obtained against the assumption of a linear dose-action curve for recessive lethals linked to either of the visible markers studied. The combined data for the two loci also showed no significant departure from linearity. Mutation rate t was calculated as 0.0049 per lethal linked to one locus, known as the R locus, and as 0.0031 per lethal linked to another locus, known as the B locus. The combined rate of lethals for both groups of lethals was 0.0039. The method did not measure the spontaneous rate of mutation or indicate any differences in the numbers of lethals carried in the stocks used in the experiments. The proportion of lethals linked to the R locus is greater than the proportion linked to the B locus at all doses of x-rays. This may be due to differences in radiosensitivity or crossing-over frequencies of the chromosomes involved, or to the possible location of the B locus close to the end of a chromosome. Recessive lethals can exert their effects at any stage of development between the egg and the adult. (auth.)


Male Drosophila melanogaster received a single dose of 5000, 5500 or 7000 r of x-radiation at 100 r/min. All the irradiated X-chromosomes which were tested for mutations were obtained from sperm which functioned in fertilization within 20 d of the treatment. The average percentage mutation per 1000 r high-energy x-rays is 1.79%. The corresponding figure for ordinary x-rays as given in the literature is 2.89%. This would indicate that the high-energy radiations are only 0.59 as efficient as ordinary x-rays for the production of lethal mutations. The reason for the difference in effectiveness is discussed. (RGA 4: 5673, 1960)


The incidence of spontaneous chromosome aberrations in first meiotic metaphases of Chlorella males is estimated to be 0.1 incomplete breaks, 0.01 complete breaks, and 0.01 interchanges per cell. After an x-ray dose of 100 r the following classes of induced chromosome aberrations were successively into maximum: (1) incomplete breaks (54 h), (2) "stickiness" (5 d), (3) complete breaks (10 d), (4) interchanges (15 d), (5) incomplete nuclei (17 d). Over the range 2 to 300 r, 0.05 complete breaks are obtained per nucleus per r. If the dose-effect curve remains linear at even lower doses, natural ionizing radiations cannot account for more than 15% of the spontaneous abnormalities of this type. Similar conclusions were obtained with regard to the complete breaks and interchanges. These findings were tested directly by exposing grasshoppers at various distances from a Co60 source for 20 d. A dose rate of 500 X background was required to produce a clearly significant increase in chromosome aberrations over control animals.


New data was obtained from irradiation of the same cell stage as that investigated in the mouse, i.e., the spermatogonial stage. Comparing the mouse radiation-induced mutation rate based on genetically tested mutations with comparable data in Drosophila, the authors estimate an average of 4.7% of the mouse mutation rate. The general magnitude of this ratio is also supported by several recent estimates of Drosophila mutation rates for autosomal loci in post-spermatogonial cell stages, provided due regard is paid to the differences between cell stages. The 1954 (1956) conclusion that the radiation-induced mutation rate "appears to be similar in mice and mice" is disputed on several grounds. Comparison between species as different as Drosophila and the mouse is difficult. It is not maintained that a final answer has been reached on the relative radiation-induced mutation rates of the two species.

* Russell and Kelly 1956 - [846]

1068 Sobel, S. 1955 - [1410]

1069 Sobel, 1956 - [1411, 1412]

1070 Sobel, 1957 - [1413]

1071 Sobel, 1960 - [1417, 1418]

1072 Sheppard, C. W., Slater, R. J., Baker, W. K. BIOLOGICAL AND PHYSICAL METHODS AND PRODUCTION OF DOMINANT LETHELS. Radiation Res. 86, 86-88 (1967). The term dominant lethals, as it is used in this paper, is a more or less different term from that used in the earlier literature, presumably because of the different processes that have occurred, resulting in dose-response curves of different nature. However, the terms are equivalent in meaning, and there is no distinction between them.

1073 Shepheard, C. W., Slater, R. J., Baker, W. K. PHYSICAL METHODS AND PRODUCTION OF DOMINANT LETHELS. Radiation Res. 86, 86-88 (1967). The term dominant lethals, as it is used in this paper, is a more or less different term from that used in the earlier literature, presumably because of the different processes that have occurred, resulting in dose-response curves of different nature. However, the terms are equivalent in meaning, and there is no distinction between them.

1074 Shepheard, C. W., Slater, R. J., Baker, W. K. PHYSICAL METHODS AND PRODUCTION OF DOMINANT LETHELS. Radiation Res. 86, 86-88 (1967). The term dominant lethals, as it is used in this paper, is a more or less different term from that used in the earlier literature, presumably because of the different processes that have occurred, resulting in dose-response curves of different nature. However, the terms are equivalent in meaning, and there is no distinction between them.

1075 Stone, W. S., Alexander, M. D. DROSOPHILA VIRILIS BY FABRICATION PRODUCTS. Radiation Res. 287-93. D. virilis were placed at several different irradiation times and intensities. The radiation was absorbed from 0-100%. The dose rates were plotted against the number of lethals, and the number of lethals was plotted against the number of errors. The proportion of lethals linked to either of the visible markers studied. The combined data for the two loci also showed no significant departure from linearity. Mutation rate t was calculated as 0.0049 per lethal linked to one locus, known as the R locus, and as 0.0031 per lethal linked to another locus, known as the B locus. The combined rate of lethals for both groups of lethals was 0.0039. The method did not measure the spontaneous rate of mutation or indicate any differences in the numbers of lethals carried in the stocks used in the experiments. The proportion of lethals linked to the R locus is greater than the proportion linked to the B locus at all doses of x-rays. This may be due to differences in radiosensitivity or crossing-over frequencies of the chromosomes involved, or to the possible location of the B locus close to the end of a chromosome. Recessive lethals can exert their effects at any stage of development between the egg and the adult. (auth.)

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A comparison was made between the time of recovery of induced crossovers and time of recovery of induced translocations in the chromosomes of irradiated *Drosophila.* (NSA 13: 8556, 1959)

* Seti 1954 - (1262)


The extreme sensitivity of the grasshopper neoblast to radiation-induced mitotic inhibition makes the determination of the dose-effect relationship very difficult, because 50% inhibition may be produced by as little as 4 r of 100-MV potential x-rays with 0.5 mm of Al filtration. By the use of sodium hydrosulfite (Na2S, O4) treatment during irradiation, a fourfold reduction of the sensitivity of the neoblast was produced by the anoxic conditions. The dose-effect relationship proved to be logarithmic in the range 5-64 r. There was no threshold and the 30% dose was approximately 20 r. Carlsson, Snyder, and Hollaender found that under aerobic conditions the amount of mitotic inhibition was independent of dose rate (0-92 r/min) in the range 2-30 r. In the low dose range x-ray-induced mitotic inhibition occurs as a phenomenon of short duration caused by a mechanism involving first-order kinetics. In contrast, a major portion of the mitotic inhibition caused by doses of x-rays greater than 128 r is of long duration, is dose-rate dependent, and has a threshold. It appears, therefore, that x-ray-induced mitotic inhibition in the dose range below 64 r under anoxic conditions and below 32 r under aerobic conditions is caused by a mechanism distinct from the one that produces the major portion of mitotic inhibition at doses of 128 r or greater.

* Shenfield 1957 - (947)


Production of dominant lethal mutations in *Drosophila* by fast neutrons has been reinvestigated with the ORNL 88-in. cyclotron. A number of changes, circums and improvements in dosimetry are described. With these improvements, the new BBE's are from 4.5 at low to 2.9 at high doses. Results of experiments at different times by various investigators are now consistent. The BBE values are still not in accord with the earlier literature, presumably owing to physical dosimetry errors. Even in our own earlier studies, errors occurred, resulting in doses which were too high by 50 to 100%. References to which corrections are to be applied are given. Typical sources of error are lack of saturation of ion chambers, misuse of tissue-equivalent chambers, and spectral dependence of chamber response. (auth. summary)

* Sobels, 1955 - (1410)

* Sobels, 1956 - (1411, 1412)

* Sobels, 1957 - (1413)

* Sobels, 1960 - (1417, 1418)


* D. virilis* were placed at neutron stations at different distances from the centre of detonation, screened from F and other ionizing radiation, and from excessive heat. The complex translocations obtained are tabulated. Translocation rates were plotted against estimated nod calculated for each test station. The data support the theory that the number of translocations produced is directly proportional to dosage of fast neutrons. Fast neutrons are much more effective in producing genetic damage measured as translocations. This difference is more marked at lower doses. A rough equivalence in damage exists for 100 rep and 750 r, 500 rep and 2000 r, and 1000 rep and 4000 r. The direct proportionality between fast neutron dosage and translocation frequency indicates that small doses of neutrons are relatively more dangerous to genetic systems.
than small doses of x-rays. The estimates of equivalent damage showing the difference in effectiveness of neutrons and x-rays agree with the report of Baker and von Halle (1954) using dominant lethals in Drosophila.

* Strömnes 1951 - 898
* Strömnes 1959 - 999
* Strundl and Gulimova 1957 - 1557
* Strundl and Gulimova 1959 - 1568

1069 Sullivan, R. L. MUTATIONS IN THE HOUSEFLY (MUSCA DOMESTICA L). Genetica 42 (1975) 406. A search of the offspring of irradiated houseflies has resulted in the discovery of a number of mutations. Most of the mutations affect the wings. Sera were found in the subclines, the anterior and posterior cross veins, and the anterior and posterior regions of the fourth longitudinal vein. Additional veins have been found arising from the posterior cross vein in the posterior regions of the fourth longitudinal vein. Other wing characters are: curvy wings, vertical (unexpanded) wings, and scalloping of the posterior margin and wing tip. Some of these are similar to mutants found by Dr. Milanis of Pavia, Italy. One mutation affects the legs, causing a swelling, thinning and twisting of the femora. In all the above cases the penetrance and expressibility of the characters is highly variable. There is considerable sexual and bilateral asymmetry in the expression of various characters. The character "shaven" causes a reduction of all bristles on the head, thorax and abdomen, leaving a short stubble. This character is lethal to flies prior to oviposition, lacking visible effect in heterozygous flies. Another character has been found which causes all male progeny. This character does not alter the size of progeny produced, indicating action prior to oviposition. All characters found to date appear to be recessive. (Abstract of paper presented at the 1957 meetings of the Genetics Society of America, Stanford, California, 26-28 Aug. 1957)

1070 Takasaki, T. STUDIES ON THE SECOND LINKAGE GROUP IN THE SILKWORM, BOMBYX MORY L. II. PALE STRIPED (P^2) AND SECOND STRIPED (S^2) INDUCED BY X-RAYS. Bull. nat. Inst., Japan 34 (1955) 10-21. (In Japanese, with summary in English)

Two mutants of the larval marking pale striped (P^2) and second striated (S^2) were found in the R^2 of the crossing of P^T x P^T x Os female with a P^T x P^T male, the female having been treated with x-rays 7 to 8 d after pupation. The mutants and their genetic origin are described in detail. A lengthy English summary presents all significant data. (NSR 7: 1345, 1955)


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

* Tazima 1958 - 309


In the silkworm the development of the germ cells in the gonads is in direct accordance with the development of the individual (both male and female), thus facilitating interpretation of results. Wild type adults were irradiated with dosages from 950 to 4000 r at various stages of larval and pupal development and mated to non-irradiated partners. At 8000 r, a noticeable decrease in oviposition resulted in early-laid irradiated females. Males reacted very differently. A markedly sensitive period was discovered at the early fifth stadium (early spermatocyte stage of germ cells) leading to a marked decrease in subsequent oviposition even at 500 r. The frequencies of unfertilized eggs and early lethals are analyzed.
taining the difference in effectiveness
(1894) using dominant lethals in

A recovery of a number of mutations
in the anterior and posterior cross
vein. Additional veins have been
found of the fourth longitudinal vein.
and scalloping of the posterior
Dr. Milani of Pavia, Italy. One
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character "shaven" causes a reduc-
table. This character is lethal to
Another character has been found
use of progenies produced, indicating
recessive.

SILKWORM, BOMBYX MORYL.
RAYS. Bull. seric. Exp. Sta. Japan
52) were found in the E of the crossing
treated with x-rays 7 to 8 d after
11. A lengthy English summary presents

COMPARISON OF X-RAY INDUCED
AND MOUSE. Mishima, Nat. Inst.

SILKWORM. I. CHANGES IN SENSITI-
IVES OF GAMETOGENESIS. Mishima.

A direct accordance with the develop-
mental and pupal development and mated
position resulted in early-irradiated fe-
was discovered at the early 5th stadium
stage in subsequent oviposition even at

tility.

1073 Tazima, Y., Ohnara, K. RADIATION MUTAGENESIS IN THE SILKWORM. II MUTATION RESPONSE PATTERN OF SILKWORM GERM CELLS TO X-RAYS ACCEEDING TO STAGE AND SEX.

Recessive mutation rates at specific gene loci, and the incidence of dominant lethals were examined. It was concluded that the germ cells of the silkworm are most sensitive to x-rays at some stages of spermiogenesis and as oocyte, whereas the oogenesin, spermatogonium and mature sperm are less sensitive.

1074 Traut, H. ÜBER DIE ABHÄNGIGKEIT DER RATE STRAHLENDIZIZITÄTER TRANSLATIONEN UND REZESSIV GESCHLECHTSFÄHIGER LETALFAKTOREN VOM STÄRKEN DER SPERMATOGENESIUM DES DROSOPHILA MELANOGASTER (The dependence of the rate of radioinduced translocations and recessive sex-linked lethal factors on the spermatogenesis stage in Drosophila melanogaster). Z. indukt. Abh. Vererbungsk. 91 (1960) 201-5. (In German, with summary in English)

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


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


The mutation rates obtained after irradiation (~1000 r of x-rays) of syngenes (fertilized eggs prior to first cleavage) were consistently much higher than those obtained after irradiation of adult males. A modified Muller 5-g method was used. The results are tabulated and their implications discussed.


When 10-20 min-old Drosophila eggs were irradiated with x-rays, the LD10 was 270 r, with an occurrence of 7.29% of sex-linked recessive lethals (tested by irradiating F1 eggs from a cross between wild females mated with Muller 5-males). Irradiation in a nitrogen atmosphere instead of in air reduced these effects, the LD10 being 580 r and sex-linked recessive lethals only 4.25%. Nitrogen treatment before or after irradiation had no effect.

1078 Valencia, J L. CHROMOSOME CHANGES IN DROSOPHILA MELANOGASTER SPERMATOZOA INDUCED BY MUTAGENICALLY COMPARABLE DOSES OF X-RAYS AND ULTRAVIOLET. (abstr.) Genetics 37 (1952) 633.

Mature spermatocytes were given a rather low dose of x-rays (about 650 r) in order to obtain recessive sex-linked lethals at a frequency (1.5%) comparable with that (1.9%) with which they had previously been produced in spermatocytes by ultraviolet. Detailed cytogenetic analysis showed that 75 of these x-ray lethals included 11 to 12 cytologically visible chromosome changes. Allowing for the moderate difference in the mutagenic doses of the two agents, the gross changes appear to be produced more readily by x-rays.
than by u.v. The present difference is not yet statistically secure, however. On the other hand, the apparent similarity in frequency of deficiencies at these comparable doses is unexpected. Although the material was carefully scrutinized for very minute deficiencies and inversions, none were found in either series. (from abstr.)

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


A number of lethals were produced, and examined genetically and cytologically in order to determine accurately the relationship between point mutation lethals and lethals associated with different types of cytologically detectable changes in chromosome structure. A low (700 r) and a high (2600 r) x-ray dose was used in order to determine the dosage relationship of the lethals. The results are tabulated. At the high dose, more of the lethals are associated with structural changes than at the low dose. Thus, structural change lethals apparently increase at a greater rate than do point mutation lethals. Point mutation lethals more nearly agree with a linear relationship, while the lethals associated with chromosome rearrangements vary approximately at the 3/2 power of the dose.


Drosophila melanogaster males of a stock which has no visible genetic markers but inversions in the X-chromosome (R.J. Muller's "buc" stock) were irradiated with fast neutrons delivered by a cascade accelerator. The 3 doses given were equivalent in effectiveness (in terms of % of recessive lethals in the X) to approximately 700 r, 1500 r and 2600 r of x-rays. The offspring of the different broods was arranged to represent sperm that was irradiated in successively earlier stages of spermatogenesis. All mutations, visible and lethal, are being analyzed cytogenetically. A considerable number of mutations have already been collected. (from abstr.)

1081 VanDaeley, B. C., Craig, G. B., Jr. RADIATION-INDUCED MUTATIONS IN Aedes Aegypti (L.) Bull. ent. Soc. Amer. 5: 3 (1959) 123, abstr. 32.

Newly emerged males of A. aegypti (L.) were treated with 3000-4000 r from x-rays or y-radiation. Their progeny were bred to the F2 generation and examined for inheritable morphologic variation. Nine kinds of visible, viable mutations were isolated and are being maintained.


Through an analysis of the frequency of allelism of 100-sec chromosome lethals induced in D. melanogaster by chronic y-radiation treatment, it has been estimated that the minimum number of loci capable of mutating to lethality under these conditions is 400 (237-718). (auth.)

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

Males and females of the one-R strain of Drosophila melanogaster were subjected to chronic irradiation in a number of experiments. In one series, chronic x-radiation was applied at approximately 106 r per day, over different periods. The sex-linked lethals in males were studied. The proportion of recoverable lethals increases linearly with dose for 20 r; there is no increase after that time. In a second series of tests, males and females carrying lethal-free second chromosomes were exposed continuously to y-rays for 15 d (approx. 2200 r) at 25°C while they developed from eggs to adults. A significant difference between the frequencies of recoverable lethals in the two sexes was found. Some further details and results are given.

(Paper presented at the 1960 meeting of the Genetics Society of America, Columbus, Ohio, 11-14 Sep. 1960)

# Wallace 1960 - (1455)


A cytological study of x-ray-induced mutations has been undertaken to determine the proportion of point mutations to those mutations which are associated with various types of structural changes of the chromosome. The mutations at eight specific loci in the third chromosome, pthp p306 csi k, were obtained by Alexander from irradiated sperm and spermatogenesis. A cytological analysis of the offspring of an individual showing two mutations, thread and scarlet, reveals a deletion of approximately 25 bands in regions 72 and 73A of the left arm of the third chromosome. The deletion includes the region which has been assigned to thread by an earlier investigator but not that which has been assigned to scarlet. Analyses of other scarlet mutations show a deletion of the regions 72F and 73A and a translocation with the break in region 75A. These three chromosomal abnormalities indicate that the scarlet gene is located in either 72F or 73A of the third chromosome. (From abstr.)


Among mutations from mature sperm which were studied, 58.0% were associated with no chromosomal aberrations, 23.2% with deficiencies, 8.9% with inversions, and 14.9% with translocations. Of these 33 mutations which were lethal in the homozygous condition, 42.4% had no detectable chromosomal aberrations, 39.4% were deficiencies, 3.0% were inversions, and 15.2% were translocations. All spermatogenetical mutations were point mutations but represented all viability categories. The genetic damage to mature sperm is higher than that for spermatogenesis when the calculation of the mutation rate for mature sperm is based on total genetic damage. (From abstr.)

# Whiting 1960 - (930)


Numerous x-ray-induced eye-colour mutations from wild type (dark brown) are reported in the chalcidoid wasp Mormoninella vitripennis (Walker). They range from dark red to "oyster" (fleav of pigment and transparent). All of these induced mutations were obtained by irradiation of females. Their hereditary character is discussed.

# Whiting, P. W. X-RAY INDUCED EYE COLOR MUTATIONS IN CHALCIDOID WASP. ABAB. Record 111 (1957) 416, abstr. 72.

Oyster white eyes and several reds have been obtained in Mormoninella vitripennis (Walker) and their method of heredity has been in part reported. Phenotypically similar eye colours have been induced in a parasitic of Drosophila pupae, Pachycrepus domesticus. Rate of mutation is high in both species.

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Nasonia vitripennis (Walker), also called Mormonella, is a chalcidid-wasp parasite of blowfly pupae. Spontaneous mutation rate is very low but many eye-colour mutations have been induced by X-rays resulting in brilliant scarlet and other reds, also in pigmentless eyes called oysters, through which the underlying black incegment shows. In the experiments described both pupae and adults of unmated females were exposed to 2500 r and the offspring haploid males bred and studied.

Whitting 1953 - [1260]


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

Whitting, A. R., Atwood, K. C. CONDITIONALLY DELAYED DOMINANT LETHAL MUTATIONS IN HABROBACON. Radiation Res. 3 (1955) 215, abstr. 16.

In the wasp Habrobracon, unfertilized eggs develop normally to become haploid males; fertilized eggs become diploid females. Females which had stored eggs in the first meiotic metaphase were X-irradiated, and one-half of them were subsequently mated. The fertilized eggs had a much higher hatchability frequency than the unfertilized eggs; however, adult survival did not differ markedly between the two groups. It appears that two classes of dominant lethal mutations can be induced: one class, comprising 60% of dominant lethal mutations, kills the eggs in a specific developmental stage whether the embryo is haploid or diploid. The other class comprises conditionally delayed dominant lethal mutations which result in death of diploid embryos at a later stage of development than haploids. Dominant lethal mutations of the former class only are induced when eggs are irradiated in the first meiotic prophase.


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

Whitting et al. 1958 - [1260]

Whittinghill, M. SOME EFFECTS OF GAMMA RAYS ON RECOMBINATION AND ON CROSSING OVER IN DROSOPHILA MELANOGASTER. Genetics 59 (1951) 399-44.

Gamma-ray treatment of 4000 r given to adult D. melanogaster females altered crossover values in a regular pattern in nucula heterozygotes. Increases were greatest, relative to controls, in the spindle attachment region in the middle of the 3rd chromosome, progressively less in each successive region farther out, and negative in the two most distal regions. Great individual variation in crossover production after irradiation was shown by regular females, by inversion females, and by regular males. The changes might have originated in meiotic or in gonial cells. The results are discussed in some detail. The crossovers induced in 14 of 59 treated males showed an even greater non-random distribution from spermatogonial crossing over. A new crossover-selector system of testing was employed. (See also earlier abstract in Genetics 35 (1950) 140-1 and ORNL-517, Oak Ridge National Lab., Tenn. 1950, 45 p.)

Whittinghill, M., Giles, A. THE MEANING OF LETHAL GENES. abstr. 49.

Whittinghill, M. CROSSING OVER IN DROSOPHILA. Suppl. 1 (1956) 189-220, Suppl. 1X- and y-rays are able to induce and to increase crossover rates in males and the increases chromosome usually affect some detail.

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Wolff and Lindley 1960

Yandres, A. F. X-RAY-TREATED DROSOPHILA ROBUSTA.

Newly emerged males and females were secured from E. fischeri. Inbred males and females were treated with 3000 r of X-rays at 1000 r/hr. The X-rays were filtered through 0.025 cm of lead and 0.2 cm of copper. At the end of the treatment, the flies were dissected for the sex chromosome; percentage of induced chromatin in other species. Slightly higher trend of reduction of fertility in D. melanogaster that do not develop into male than in species where sex seems most probable that it could be due to the chromosome aberrations in the physiological age.

(ABSTRACT OF PAPER PRESENTED AT THE 8th-10th SEPT. 1965)


Newly emerged Drosophila were treated in groups of 20 to 25 at a rate of 1500 r/hr. After irradiation with 8000 r, 1000 r/hr. After irradiation, males were mated to females to determine the effect of dominant lethals, as data are reported. The present data are limited, but a larger proportion is likely to be represented.

Yandres, A. F. THE EFFECT OF X-RAYS ON DROSOPHILA. Proc. Nebraska University Abstr. 11

Yandres, A. F. X-RAY-TREATED DROSOPHILA ROBUSTA.

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