so that loss of insecticide from the surface may be followed by measuring loss in radioactivity. Different samples of mud were made into blocks under various conditions of humidity, and a homogenous mixture prepared by dissolving 300 mg pure p-gal-DDT and 9.3 mg radioactive p-gal-DDT (specific activity 0.48 mc/g) in carbon tetrachloride, evaporating the solvent, drying the residue over silica gel and grinding it to a fine powder. Each block was then dusted with the powder, with about 1 mg. DDT particles ranging from 1-90 μ in diameter, deposited from a stream of nitrogen. An average cover of 4280/m² was obtained immediately after dusting. The subsequent rate of loss of radioactivity of the block in a dry atmosphere was tested, and the percentage of DDT in different layers determined. No DDT was found at a depth below 1.5 mm.


DDT (2 mg. per fly) was applied to the labela or to the otho-femoral membrane of one leg of males of Musca domestica L. that had emerged four days earlier. Treatment of the labela gave 92% kill in 24 hours, and treatment of the leg gave 65%. When the cervical region of each fly was ligated with cotton thread, the mortality percentages were 91% and only 51% for flies treated on the labela and leg, respectively, and 16 for flies not treated with DDT. When DDT labelled with C¹⁴ was used, and the heads and bodies of the flies were separated 24 hours after treatment and tested for radioactivity, all the radioactivity applied was recovered and the percentages of it recovered from the heads of non-ligated and (in brackets) ligated flies were 70 (80) after treatment on the labela and 5 (less than 1) after treatment on the leg. Radioactivity in the hemolymph of flies treated on the leg could be detected 30 seconds after treatment, rose fairly rapidly during the first 3 minutes and then remained at a more or less constant level for 24 hours. It is concluded from these results that DDT is translocated in the hemolymph of the fly, and that the head is probably a critical region for its lethal action. (RAE 946; 168, 1955)


A method has been developed for the synthesis of radioactive dichlorophenyl trifluoromethane (DDT) of good yield, in which the tertiary carbon is labelled. (For details, see abstract under "Preparation of carbon-14-labelled DDT" in J. Agric. Food Chem. 1, 7-4 (1953) 770).


Studies on degradation products of DDT in seven DDT-resistant strains of houseflies, using radioactive DDT (C¹⁴ labelled in the tertiary position), showed that the only significant product of DDT metabolism was DDE. Both DDT and DDE were found in the water-soluble portion of the excreta. The DDE-DDT ratio increasing with increasing time intervals. Very small amounts of a radioactive product were found in the water-soluble portion of the excreta. Loss of DDT were not constant and are thought to be within the range of experimental error. No specific specificity was evident. In flies held 20 days after application of the insecticide, small but consistent losses of DDT were experienced, which might be attributed to incomplete recovery of material from excreta. (Auth.)


The synthesis of DDT labelled with C¹⁴ in the tertiary position was carried out in the following steps: barium carbonate to ethanol anhydrous to ethyl alcohol to chloroform to DDT. Starting with 90 mg of barium carbonate containing 30 mcg of activity, 15 g of crude DDT were obtained (45% yield based on ethyl alcohol). Two crystallisations from ethyl alcohol yield 8.11 g of p-DDT (17% yield having a melting point of 107-109.5°C. The specific activity was approximately 0.5 mc/g. (author))


C¹⁴-labelled DDT was incorporated into digested human blood. This was fed to adults live through chelated mechanisms. The DDT-resistant (Romoa) strain rice and the susceptible rice (Oryza sativa) could be shown to metabolize DDT to a water-soluble derivative giving a positive test when analyzed by the Scholander-Whatier method. The metabolism was not ether-extractable following acid hydrolysis but appeared to be in a conjugated form, possibly with a protein fraction.

Radioactive DDT and DDE, topically applied to American cockroaches, are rapidly absorbed and widely distributed internally. As much as 70% of the DDT applied is excreted as metabolites in the faeces over a 24-h period. About 10% of the radioactivity in the faeces is due to metabolites containing the diphenyl-2-carbon moiety of DDT; less than 1% is due to DDT, DDE or DDA. Less than 1% of DDT applied or injected is excreted as C14CO2. The synthesis "pipernyl cyclazine" used with DDT, inhibited absorption of DDT and excretion of metabolites. (auth.)


Resistant houseflies, Musca domestica L, treated individually with measured drops of radioactive DDT absorbed 64% more of the carbon with a lower mortality when held during a 24-h period at 90°F than when held at 70°F. Absorption of the DDT began within the first hour after treatment and gradually increased over several hours. Approximately the same amount of DDT was absorbed irrespective of whether the fly was immobilized with carbon dioxide or was active. The excretion of treated flies showed some radioactivity. Approximately 19% of the total absorbed was accounted for in the excrement over a 7-day period. No radioactivity could be demonstrated in the carbon dioxide collected from DDT-treated flies. (auth. summary)


Radioactive DDT was used, labeled as the tertiary carbon with C14 (cf. Pearse & Jensen, 1938). Of the intravenously absorbed, radioactive DDT administered unaltered to rats with their thoracic lymph ducts cannulized, 47-65% was recovered in the bile. Furthermore, 14-45% of the absorbed DDT-derived materials (found in the bile were dehydrochlorinated into a neutral material (DDE)).


Fourth-instar larvae were used in the tests. The insects used were Diptera, Linnaeus, Panthelus, Maladi, and radioactive DDT (p₂₂²⁺⁻⁻⁻⁻C14 with an activity of 2.16g/mg). The mortality of mosquito larvae increased at the volume of water-space-suspended solutions of DDT, Linnaeus, Maladi, and DDT was increased from 1000 to 10000 ml. The increase was greater and more consistent with DDT than with the other larvicide and with larvae of Anopheles quadrinaculatus Say and Aedes mesquitalis (Wied.) than with Aedes aegypti (L.). No increase in mortality was caused with Panthelus. When the diameters of the test containers were increased from 3 to 4 inches but the concentration and volume of the suspensions or solutions were constant, mortality of quadrumaculatus decreased when 25% of the fly was placed in the test tubes, but not with Maladi or Panthelus. No difference in mortality was observed with the other two species of larvae. (from auth.)

Stone and Schoonhoven 1955 - [728]


The availability of C14-labeled DDT and of radiometric methods permitted quantitative studies on the toxicological aspects of DDT poisoning in mosquito larvae. In tests by radiometric methods, the amount of DDT picked up in relation to the mortality of fourth-instar larvae of Anopheles quadrimaculatus Say, Aedes mesquitalis (Wied.), and Aedes aegypti (L.) varied with the exposure time and the concentration. Larvae did not excrete DDT except when exposed to concentrations above the minimum LD₅₀. The toxic action of DDT on quadrimaculatus larvae differed from that on aegypti. Resistance to DDT in a strain of mesquitalis was not related to the uptake or the excretion. Live quadrimaculatus larvae absorbed three times as much DDT as dead larvae; however, in a 24-h test period the surviving larvae had about the same dose as the survivors.

(An abstract of earlier work was published in Bull. ent. Soc. Amer. 4, 3 (1958) 103, abstr. 266)

The concentration of DDT in suspensions was shown to be less than the theoretical, and to vary with the volume of the suspension and the size of the container. This variation resulted from differences in the loss of DDT by condensation and/or by association with the water interface, which explained the existing differences in mortality. The mortality of Aedes quadrimaculatus Say was influenced more than that of Aedes aegypti (L.), owing to a difference in the behavior of the larvae and the emersion rate. Biological data obtained with Parathion, Malathion, Lindane, and Dieldrin indicate that insufficient quantities of these insecticides are lost from the containers to alter mortality under normal test conditions. (aut.)

C-labelled DDT was used throughout.


Since the insecticidal properties of DDT are similar to normal DDT and there is no reason to expect any fundamental differences in their metabolism, the parameters and metabolism of (B)Cl, CH, CCl, by susceptible and resistant strains of the housefly Musca domestica were studied by labeling it with C.

Preliminary penetration studies indicated that DDT-resistant flies were also resistant to DDT but their resistance was not associated with decreased absorption of the applied insecticide. Metabolism of DDT in DDT-resistant flies was only observed in DDT-resistant flies. Results suggest that the metabolism is enzytic in nature. Metabolism appears to insufficiently rapid to account for the successful resistance of the flies used in these experiments. Alternatively, only a small fraction of the applied insecticide is involved at the site of action, but it is this fraction which is metabolized. To check whether this presence of DDT in DDT-resistant flies was observed.


The author used a hormone (E2) analogues of DDT for treating two resistant and two susceptible strains of houseflies (from Italy and Tunisia, and from Italy and England respectively). Both adults and larvae were used for studying the metabolism of DDT. Both strains were able to metabolize the compound provided the dose absorbed was sufficient; the resistant strain degraded the insecticide more rapidly than the susceptible strain did; however, only the intact, living flies were capable of metabolically degrading the absorbed insecticide. At least two kinds of DDT-resistance were observed, one represented by the Italian strain in which survival appeared to depend upon a mechanism such as enzymatic dehydroalkylation and the enhanced metabolism which was a consequence rather than a cause of survival.


The 14C-labelled mouse technique was used for studying the effects of DDT and Dieldrin. Experimental details are given. The major soluble phosphorus compounds were uniformly labeled in vivo, extracted and assayed as explained elsewhere (Winteringham, 1969). A significant breakdown of the metabolic activity in DDT-poisoned houseflies was noted at the late posture stage. This fall could be reversed by injecting aqueous glycerine. A significant breakdown in insects stored the hypermetabolic activity in cyclopropene anaesthesia; cyclopropene also failed to prevent the enhanced deactivation associated with DDT poisoning. The fall in ATP and respiration rate of DDT-poisoned houseflies is not due to the exhaustion of endogenous reserves or to the hypermetabolic activity induced by DDT. In both DDT- and Dieldrin-poisoned houseflies there was a fall in the level of trophon and glycerophosphate, which could not be reversed by cyclopropene anaesthesia.

121
Brooks, G. T. SYNTHESIS OF CARBON-14-LABELLED 1,2,3,4,11,12-HEXACHLORONAPHTHALENE (ISODIN) and Isochin. Chir. and industr. (Rev.) (1963) 194.

Adipic acid-1,6-C¹⁴ (0.13 μg) was oxidized with Ba(OH)₂ to give cyclohexanone-1-C¹⁴, which reduced with NaBH₄ gave cyclopentanone-1-C¹⁴, dehydronation of which with P₂O₅ gave cyclopentane-1-C¹⁴, which brominated gave 1,2-dihydrocyclopentanone-1-C¹⁴, which dehydrobrominated gave cyclohexadiene-1-C¹⁴, which condensed with excess 1,5,8,4,7,7-hexachlorobicyclo[2,2,1]hepta-2,5-diene gave "isochin"-d₁⁴ and 7-C¹⁴ (1.1 kg). A total of 0.1 μg C¹⁴ gave 70% II. (CA 52: 10988a, 1958)

Brooks, G. T. THE SYNTHESIS OF 14C-LABELLED 1,2,3,4,10,11-HEXACHLORO-6,7-EPoxy-1,4,4a,5,6,7,8,8a-OCTAHYDRO-EXO-1,4-EXO-6,6-DIMETHANONAPHTHALENE (ISIODIN). J. chem. Soc. (1963) 8039-47.

A study of the absorption, metabolism, and excetration of insecticides derived from dehydro-1,4,5,8,-dimethanoanthracene required a method for the preparation of 10-millimolar scale of such compounds labelled with 14C, 14C-labelled Endrin has now been synthesized by peracidic acid oxidation of 14C-labelled isodrin prepared by Dien-Aldol addition of [3-14C] cyclohexadiene to 1,2,3,4,7,7-hexachlorobicyclo[2,2,1]hepta-2,5-diene.


Topically applied isodrin and Endrin (14C-labelled in the terminal chlorinated ring) were found to be less toxic than Aldrin and Dieldrin to susceptible hosts but more toxic to Dieldrin-resistant houseflies. Both strains of houseflies converted isodrin to the corresponding epoxide Endrin. Small amounts of Endrin also were recovered in the external time. (Nichols, metabolism, and excretion of the insecticides and the presence of residual material in tissues are discussed. Endrin was not found in the tissues of heart-killed insects, suggesting an enzymic epoxidation. Acetone-extracts of live houseflies treated with isodrin or Endrin contained small amounts of a radioactively-inducible product, which behaved as a ketone derivative of Endrin. There was no evidence that radioactive material was excreted.

Miscellaneous


Bromacetic acid disappeared from the blood in 45 minutes. Radioactivity of the tissues varied directly with the dose administered, except in the intestine and the Malpighian tubes where it varied later. The radioactivity in muscle is slight, and occurs mostly in the most highly pigmented muscles which are richest in radioactive dehydrogenase. When the dehydrated extracts are separated by electrophoresis, 2 electrophoretic and 2 electrophoretic negative compounds may be distinguished by autoradiography. (BS: 17-10541, 1958)


Doses of 90, 120, and 560 y of bromacetic acid-2-C¹⁴ (0.14 g) were injected into cockroaches (Periplanta americana) and their blood was studied. A maximum of activity appeared 10-10 minutes after injection, and it disappeared within 30 minutes. Radioactivity was proportionally to the amount injected in various parts of the body, but not in the colon and the Malpighian tube. Electrophoreses on paper of dehydrated extracts produced 2 electrophoretic and 2 electrophoretic negative compounds (after injection of j), the major component resembling 3-(2-furanylmethyl)glutarimide in migration rate. Further work on the subject is also reviewed. (CA 52: 14814, 1958)


The insecticide 6,7,8,9,10,11-hexachloro-1,3,5a,6,7,8,8a-octahydro-6,6-dihydrocyclopentadiene-1-cyclohexadiene-1-C¹⁴a (Theodan-5a, 9a-C¹⁴) was prepared for use in biological studies which required that quantities as low as 1 part per billion be detectable. Starting with a 413-nm quantity of

barium carbonate-C¹⁴, the chemical yield was 51%.

Halberstadt, J. SOME EXPERIENCE WITH 14C-DIPPENI SULPHONE, A NEW INSECTICIDE. The insecticide was applied to apple trees. Toxicity tests. (CA 53: 10988a, 1958)

Halberstadt, J. TESTS ON THE EFFICACY OF THE NEW INSECTICIDE "TEDUS" (1958). Apple trees were sprayed with powder and as a missile oil, leaf for a long period, without the plant, being continuously economical in use as the N weight, about 40 to 46% of it is broken down. (An early summer "Deutsche Meise" as an insecticide) (1957) 317.


Hollander, M. UEBER DIE AUF (1957) 317.


A review article of a general.


Schnardt (octamethyl glyoxythioleoplatin) not cerebrospinal fluid levels in a variety of concentrations in certain rapidly possible undesirable substances i biochemical behaviour and re

Wittmann, R., Schwander, G. FCENTRAL SHIPHONIC ACID A practical applicability of constants in the temperature tabulated form. p. 22 was used
HEXACHLOROBENZOTRIAZINE
1-1-C\(^{14}\), which reduced with Na\(_2\)BH\(_4\)

HETEROCYCLOPERIDOL, 1-1-C\(^{14}\), which brominated

a cyclopentadiene-1-1-C\(^{14}\), which

b-diene gave "isotride"-9 and

9)


derived from decalin-4,5,6,7-tetramethyl, 9-1.23-1

equimolar scale of such compounds

\(\text{C}_{14}\)-labeled to 1, 2, 3, 4, 7, 7-hexachlorobicyclo

(6.6.1) MUSCA DOMESTICA TO

blotted ring was found to be less

to Dieldrin-resistant hom telites.

S. Small amounts of Dieldrin

excretion of the insects

in the tissues of heart

five hemolymph treated with

breakdown. (auth. summary)

NACETICO MARCATO CON C\(^{14}\)

propionic acid on injection into


6) CHOL-1, BRONCO., AND CHLORO-

some of their derivatives.

placed into cockroaches (Periplanta

6 - 10 minutes after injection.

of various lipids on paper of deproteinized

active components (after injection of

migrazione nera. Earlier work on the

KMag, H. ISOTOPE-LABELED

p. 103-6.

9) - 8, 9-methano-2, 4, 3-benzo-

use in biological studies which

with 411-mc quantity of

barium carbonate-C\(^{14}\), the quantity of final product obtained was 210 mc, which represents a radio-

chemical yield of 37%.

Halberstadt, I. SOME EXPERIMENTS WITH RADIOACTIVE PREPARATIONS OF 2, 4, 5, 6-TRIHALO-


A scientific note on the method of preparation of the compound, and on experiments in which

it was applied to apple trees. Toxicity test on rats and their results are reported. \(^{89}\) was used for labeling.

Halberstadt, I. EXPERIMENTS WITH RADIOACTIVE PREPARATIONS OF THE ACARICIDE 7-TEKRON TNC.


Radioactive tracer techniques are applied to investigations into the behaviour in plants and animals of

"Teckon" in (as a control for the control of spider mite. The sulphur in the active ingredient of

Teckon, which is 2, 4, 5, 6-tetrachlorophenyl sulphone, is partly replaced by the radioactive isotope \(^{42}\). Apple trees were sprayed with preparations of this radioactive Teckon in two formulations: as a wettable powder and as a mist oil. Radioactivity measurements showed that an active residue remains on the

leaf for a long period, whilst the Teckon taken up by the leaf is subject to evaporation and transport within

the plant, being continuously supplemented from the surface residue. The mist oil oil proved to be more

concentrable in use than the wettable powder. Administration to rats (max. dose 100 mg per kg body

weight), about 40 to 45% of the Teton is found unchanged after 48 hr, mainly in the faeces; the remainder

is broken down. (auth. summary)

An earlier abstract: "Determination of uptake and loss in plants and animals of 2, 4, 5, 6-tetrachlorophenyl

sulphone, a new acaricide as measured with the aid of \(^{42}\) appeared in liter. J. appl. Radiation

1960, 217.

II - D Organic Phosphates

Survey Articles

Heath, D. P. SOME APPLICATIONS OF \(^{32}\) P TO THE STUDY OF SYSTEMIC INSECTICIDES. p. 106-20 in


Hübner, M. ÜBER DIE AUFNAHME RADIOAKTIVER KONTAKTINSECTIZIDE BEI PFLANZEN und TIESEN

(Staub on the absorption of radioactive contact insecticides by plants and animals). Nachr. Chem.

[1958] 192-4. (in German)

Relevant work reviewed from 1944 to 1954. With one exception, the radiisotope employed was \(^{32}\).

Metcalf, R. I. RADIOACTIVE TRACERS IN STUDY OF SYSTEMIC INSECTICIDES. Agr. Chem. 3, 3 (1964)

33-35, 128-20.

A review article of a general, introductory nature. 3 references.

Métalaff, R. L., March, R. B., Faduto, T. R. STUDY OF SYSTEMIC INSECTICIDES. Calif. Agric. 5, 6

(1956) 6-11.

Schneidman (2-methyl-2-pyridine-aldehyde) and Demeter or Syrox (O, O-dimethyl (2-ethyl-benzamidro) phosphoramide) and their derivatives have shown unusual promise for the control of mites and aphids and other sucking insects on a variety of agricultural crops. These materials are freely transmuted in the plant and concentrate in certain rapidly growing tissues. It is necessary, therefore, to have detailed knowledge of possible undesirable residues in edible produce. Radio-phosphorus tracers were found to aid basic studies on biochemical behaviour and routine analysis of residues in treated produce. (Ref. 29) 20086, 1959.


The practical applicability of phosphoric esters depends largely on their hydrolytic stability. The hydrolysis

constants in the temperature range 20-70°C and for pH 1-9 were determined. The results are presented in

tabulated form. \(^{18}\) was used throughout for labelling.
COMPARATIVE TOXICOLOGY OF SOME ORGANOPHOSPHORUS COMPOUNDS IN INSECTS AND MAMMALS. /ADV. J. Biochem. Physiol. 27 (1939) 113-22.

A review article. Principles of selective toxicity are discussed. Some unpublished work by Kneger is mentioned who investigated Malathion metabolism in insects employing some unlabeled and phosphorus-32-labeled compounds, and separating the metabolites from by column chromatography. Results of chromatographic analysis on an ion-exchange column of metabolites in the bodies of flies 4 h after topical application of radioactive Malathion (100 mg/kg) are shown in a figure. Nine water-soluble degradation products, not the expected 2 were produced. Periplaneta americana, Musca domestica and Musca domestica all degraded Malathion to the same extent and to the same products but the toxicity, particularly for the flies, differed widely.


A section (p.246-58) in chapter 18 (Techniques) is devoted to malathion synthesis using P32. The phases in synthesis are (a) exchange, whereby the ethyl radioactivity is transferred to the ester material; (b) synthesis of a P intermediate such as 

Section 18: Innertherapeutische Insektizide (insecticides with internal therapeutic action) /Z. Pflkraub. 29 (1963) 89-100 (in German)

The review gives an outline of the development and present state of knowledge in the internal therapy of plants, and deals briefly with products which have a systemic action. Pyramoxin [O-dichloro-, O-dichloro- and (monochloropropyl)phosphate] (water-soluble 10,000 ppm) showed good systemic action after trunk application to apples, root absorption in beans and seed treatment of rice. Experiments with P32-labeled Pyramoxin showed that it was distributed throughout the entire apple plant following application to root, stem or a single branch.

Chlorinated - A NEW ACARICIDE AND SCALICIDE. /J. Econ. Entomol. 2 (1969) 817-84.

Investigation on the behaviour of P32-labeled Chlorinated (O, O-dichloro-4-methyl-4-phenyl-ethyl phosphonothioate) and its salts in plants showed that Chlorinated penetrates the cuticle and is translocated readily through the plant in solutions of all 1-2 kg or more per ha as an acid solution, probably because the salt does not occur in these. Acaristothecium concentrations have little effect on insect predators, probably because the oxalic has no fungicidal action and only low contact action. At times the acaristothecium concentration, the Chlorinated has no effect on Hipponeura quinquemaculata (i.e., killed less than 10% of soybean plants). But it was slightly more harmful to Aphids (Macrophyes incisus Thienh.) and Cytos lepidoptera (May).

Co-Ral

Chlorinated et al. 1969 - [768]


Only small amounts of P32 were absorbed through the skin and eliminated to the urine following dermal application of the compound to cattle. High levels of the unchanged toxoid were found on the hair several weeks after treatment. The compound was ineffective as a systemic against stable flies and screwworm larvae but highly effective against these insects by contact. Oral treatments, 10 and 20 mg per kg, approximately 25% of the dose was excreted in urine as polar degradation products and about 85% in the feces 7 days after treatment. (auth.)

Kreger, H.R., Castiles, J.J. INSECTICIDES. METABOLISM TO RATS, A GOAT, AND A CO-Ral was applied directly sacrificed at predetermined fish in intake. Other factors low and its oxygen analogue, the solution, levels of Co-Ral an activity, milk residue, and i-1 labelling. (auth.)


The fate of orally administered 2-chloro-4-methylphenol has shown P32-labeled compound compound was rapidly metabolized in the urine within 24 hours and the urine was not due to the in vivo radioactivity were found in that after dosage, small but significant.

(See also abstract in Biological Abstracts 1969.

Radeloff, R.D., Clahorn, H. /Food Chem. 8, 6 (1969) 839-842.

Co-Ral, O-G-chloro-4-methyl is an effective systemic and excised in milk of sprayed c organso-phosphate extractive Co 0.25 ppm, respectively, for levels declined gradually over 21 days.

Robbins, W., Hopkins, T. BAYER 21/199 AND ITS DERIVATIVES.

The joint oral administration chloro-methylphenoxybenzene from to six-fold. This occurs by different routes. Plants, fungi and cholinesterase by 21/199 or the joint administration of pl.


The metabolism, excretion, spray application of two herb and those believed like polar about 2,4,5-trifluorobenzoic and two animals 2 weeks after the believed fish 21/199 were present externally. (auth.)

Schmidt and Wellman - [759]

Vickers, D.S., Ashby, B.W. CO-RAL. /J. econ. Ent. 63

Co-ral was applied dermally to rats, a cow, and a goat at 50 to 45 mg per kg. The animals were sacrificed at predetermined intervals and the tissues were tested chromatographically, for residues of the insecticide. Other factors investigated were the in vitro and in vivo opening of the pyrene ring in Co-ral and in oxygen analogues, the ease of excision of Co-ral and the oxygen analogue from proteinaceous solutions, levels of Co-ral metabolites appearing in blood, and the effect on the blood cholinesterase activity, male castrates, and the nature of the products excreted in the urine and feces. 51S was used for labeling.

(For)


The fate of orally administered bayer 21/199 (O-5-diethyl(2-chloro-4-methylphenyl)phosphorothioate) which has shown systemic activity against Hypodermus in cattle, was studied by administration of the 52P-labeled compound to white rats at an average dosage of 20 mg/kg body weight. The compound was rapidly metabolized and excreted. About 72% of the radiactivity of the original dose was excreted in the urine within 24 h. Paper chromatographic analysis followed that the radiactivity in the urine was not due to the bayer 21/199 but was associated with more polar compounds. Smaller amounts of radioactivity were found in the feces, bile, lymph and blood. Among samples of various tissues taken 24 h after dosage, small but significant amounts of radioactivity were found in bone, liver and kidney. (For)

(See also abstract in Res. Soc. Agric. Ent. 2, 3 (1957) 26, abstr. 54)


Co-ral, O-(2-chloro-4-methylphenyl)phosphorothioate, also known as bayer 21/199, is an effective systemic and contact insecticide for livestock use. To determine whether it would be excreted in milk of spayed cattle, dairy cows were spayed with 0.5 and 0.75% concentration. Maximum organo-soluble extractive (Co-ral plus other organo-soluble compounds) was approximately 0.2 and 0.25 ppm, respectively, for the 0.5 and 0.75% concentrations, reached 5 h after treatment. These levels declined gradually over 7 days, being only a trace at 10 days. 5P-labelled Co-ral was used.


The joint oral administration of piperonyl butoxide (1:9) increased the toxicity of both Bayer 21/199 (O-(2-chloro-4-methylphenyl)phosphorothioate) and its corresponding phosphate to mice from 5 to 100. This increased toxicity was also found when synergist and toxidote were administered by different routes. Piperonyl butoxide increased the in vitro but not the in vivo inhibition of mouse brain cholinesterase by 21/199 or its phosphate. Preliminary studies with 5P labelled 21/199 demonstrated that the joint administration of piperonyl butoxide inhibited the metabolite to more polar metabolites. (For)


The metabolite, excretion, and tissue distribution of 5P-labelled Bayer 21/199 have been studied following spray application of two disposable tanks. Only low levels of radioactive compounds were found in the blood and those behaved like polar degradation products. The compound appeared to have been sparingly absorbed, about 2.4% (capillary) and 3.5% (injection) of the applied dose being accounted for in the urine of the two animals 2 weeks after treatment. At that time only very low levels of organo-soluble compounds which behaved like 21/199 were present in the tissues, but a considerable residue of unchanged 21/199 was present externally. (For)

Schmidt and Weidma - [737]


125

Technical Hercules AC-528 (Delnav) was separated by partition chromatography into 8 different fractions. The major components were the cis and trans isomers of 2,3,5-trIDEOXY-(+) hydrocortisone, 2,3,5-trIDEOXY-(--) hydrocortisone. The structure, toxicity to houseflies and rats, and anti-cochleate activity and stability to alkali hydrolysis were studied for these 8 Hercules AC-528 components. Radioactive transporter AC-528 was prepared and the metabolism in rats and cockroaches studied for the cis and trans isomers, 2,3,5-trIDEOXY-(+) hydrocortisone and 2,3,5-trIDEOXY-(--) hydrocortisone. In a wide variety of in vitro and in vivo biological systems the cis and trans isomers were the most stable of the radioactive compounds. An additional action was a study on hydrolysis by human plasma where the diastereoisomer derivatives were the most stable. In a sub-acute feeding study with rats, Hercules AC-528 was found to accumulate to a small degree in fat. However, the residues disappeared rapidly when feeding of Hercules AC-528 was discontinued. Other factors in investigating Hercules AC-528 included; cochleate depression and recovery in rats following administration of a sub-lethal dose; the sub-acute feeding on rat plasma, and blood coagulation and basic cochleate activity; metabolism of the components of Hercules AC-528 by Porphyrio americanae and to liver tissues; the formation of more polar, non-hydrolyzed metabolites from the radioactive components by rats and cockroaches; and the nature of the hydrolysis products formed from the components in human plasma and following oral administration to rats. (auth.)


252-Delnav-15O, 2,3,5-trIDEOXY- (+)-hydrocortisone and 2,3,5-trIDEOXY-(--) hydrocortisone was applied to a spray to a Hereford steer and the residue and metabolite pathways were determined. Fatty tissues accumulated small amounts of the isomeridate, but did after treatment most of the dose was still on the hair. No residues were found in meat samples. The metabolic degradation of the insecticide in mice was not affected by the course of administration. Paper and alumina chromatography demonstrated the presence of phosphate and/or phosphocholesterol compounds in some of the minor fractions of technical Delnav. (auth.)

Note by the editor: Delnav-15O is also known as Hercules AC-528.

(A severe of earlier work was published in Bull. ent. Soc. Amer. 41, 8 (1955) 41, alsor. 196, under "Residues following pograph of 252-labeled Hercules AC-528 (Delnav) to a Hereford steer").

DPP


James's method (J. Biol. Chem. 173 (1948) 429) for calculating the initial concentration of enzyme active centers and the turnover number can only be applied to enzyme preparations of a purity which has not been achieved for most microorganisms. Such preparations of enzyme contain non-enzyme groups (implanations and perhaps facsimile DPP). The combination photo-...
(Impurities and perhaps fractions of the enzyme molecule itself) which would then also combine with DFP. The combination product that contains more DFP than enzyme-active groups than groups other than the ones associated with enzyme activity are labelled. The paper presents two methods employed successfully to overcome these difficulties, which result in reliable figures for similar concentrations of active centres and for the turnover number in crude and partially purified preparations of ox red cell cholinesterase.


Botulinum botulinum was capable of combining with DFP. The combination was found to be mainly due to the al-esterase present in the serum. The true cholinesterase of the serum accounts for only a minor percentage of the DFP bound. The reaction products of DFP with highly purified preparations of true and pseudo-cholinesterase were prepared by ion-exchange of the enzymes concerned with DFP. For these enzyme preparations turnover numbers could be established. The figure found for true cholinesterase confirmed the value previously reported (25800). A turnover number of 5600 was found for pseudo-cholinesterase. The reaction product of DFP with al-esterase, true and pseudo-cholinesterase were hydrolysed and subjected to chromatography on Dowex-50. In all three cases the bulk of the radioactivity proved to be associated with the inorganic phosphate and to organic phosphate fractions of the chromatograms. The results suggest that the C1 groups of serine might be of importance in the combination of DFP with the active centre of the enzymes concerned.


On paper electrophoresis the pseudo-cholinesterase activity of human serum is localized between the α-2 and the β-peaks. The same localization is found after electrophoresis on starch column. Thoroughly dialyzed DFP-treated human serum as well as serum obtained from human a few days after the injection of DFP were subjected to electrophoresis. No radioactivity could be detected on the paper electrophoretic strips, but after column electrophoresis it was possible to localize the radioactivity between the α-2 and the β-peaks. The conclusion is reached that in human sera, which have been in contact with DFP, only one component, the pseudo-cholinesterase, is irreversibly labelled by DFP. The values obtained for the turnover of serum proteins by means of DFP therefore clearly reflect the turnover of the pseudo-cholinesterase component.


A new technique was developed in order to translocate the detection of unstable DFP-enzyme derivatives, whereby the phosphorylated enzyme could be rapidly separated from excess DFP and its hydrolysis product DFP. Use was made of a column of Dowex-50 x 2 cation exchange resin, 200-400 mesh, in the NH₄⁺ form. The column was packed in a polyethylene tube and pre-treated with 0.1 M sodium citrate buffer pH 3.6; an aliquot of the reaction mixture of the enzyme with DFP is then applied to the top of the column and moved through under pressure. Upon elution with 0.1 M acetic acid, DFP and DFP were rapidly eluted, with clear separation from each other, while the labelled protein was retained at the top of the resin. It could be located by monitoring the column, and then eluted using column and rinses in that region and eluting the labelled protein by suspension of the resin in 1 M NaOH. The results of the above and of dialysis experiments are given in tabulated form. No evidence was found to support the hypothesis that the phosphorylation of albumin constitutes the initial stage of the combination of DFP with trypsin.


Rabbit and guinea-pig sera were submitted to electrophoresis on starch columns and on filter paper, in order to separate the serum esterases and cholinesterase and to determine the nature of serum proteins which are combined with DFP after intra-muscular injection of DFP. Three days after injection, the radioactivity is located only in one part of the esterase activity (perhaps on E-esterase) in rabbit serum. In guinea-pig sera, it is located mostly on E-esterase and partly on another protein which is very probably cholinesterase. The implications of the results are discussed. (From auth. summary)
A method is described for the preparation of phosphinic acid from radiiodinated chymotrypsin. (auth.)

Saunders, B.C., Worthy, T.B. 
FLOPHOSPHINIC ACID (F.P.)
The preparation of $^{32}$P-labeled F-P (CH$_2$$_2$PO$_2$H$_2$) on a $\frac{1}{4}$-g sc scale operation and which takes place at a temperature of $200 \pm 50^\circ$C. The yield of F-P is approximately 95%. (auth.)

PHOSPHINIC CHYMOTRYSIN.
The nature of the combination reaction product of diglycophosphoryl fluoride, partially hydrolyzed by photolysis, was obtained by chromatographic analysis. The product in the test of these enzymes, and its chromatographic properties, are described. (auth.)

PHOSPHINIC DERIVATIVE OF $^{32}$P-

The reaction of diglycophosphoryl fluoride, labeled with $^{32}$P, was studied with HCl. Serum phosphoric acid was isolated by fractionation with formic acid and with the phosphoric acid. (auth. summary)

Schaffer, N.K., Hamburgh, E. 
CHYMOTRYSIN IN VITRO.

$^{32}$P-labeled diglycophosphoryl fluoride, prepared by digestion with Dowex 50 cation, was converted to diglycophosphoryl fluoride, the normal digestion sequence in the test of these enzymes, and its chromatographic properties, are described. (auth.)

Schaffer, N.K., Scharf, B. 

$^{32}$P-labeled diglycophosphoryl fluoride, prepared by digestion with Dowex 50 cation, was converted to diglycophosphoryl fluoride, the normal digestion sequence in the test of these enzymes, and its chromatographic properties, are described. (auth.)

Schaffer, N.K., Engel, R.P., Shih 
$^{32}$P-LABELED PHOSPHATECA MIND.

$^{32}$P-labeled Sada diglycophosphoryl fluoride, prepared by digestion with Dowex 50 cation, was converted to diglycophosphoryl fluoride, the normal digestion sequence in the test of these enzymes, and its chromatographic properties, are described. (auth.)
A method is described for the preparation of \( ^{32}P \)-labelled diglycerophosphonofluoridate in water or oil solution starting from radioactive phosphoric acid. The specific radioactivity amount to 200 mc/mg. (auth.)


The preparation of \( ^{32}P \)-labelled DPF is described. Details are given of the preparation of radioactive PFO (OCH\( \text{Me}_2 \))\( _2 \) on a 1-g scale; a modified apparatus is described which is suitable for the multiple-scale operation and which takes into account the volatility of the radioactive intermediates and final product. The \( ^{32}P \) used had an activity of 20000 cpm/mg and the resulting 1 activity of 2800 cpm/mg. The yield of 1, prepared according to CA 45: 0740 h, is 60%. (cf. CA 45 (1960) 1119).


The nature of the combination between chymotrypsin and DPF was investigated with \( ^{32}P \)-labelled DPF. The reaction product of diglycerophosphofluoridate (DGF) and chymotrypsin, diglycerophosphonofluoridate, was partially hydrolyzed by papain trypsin, and 2 N HCl or directly with 2 N HCl. Serine phosphoric acid was obtained in 95% yield from the hydrolysate by fractionalization with Dowex 50 chromatography. The product has a nitrogen to phosphorus ratio of 1.0 to 1.3, contains 1 mole of serine per atom of phosphorus, and could not be distinguished from authentic serine phosphoric acid by paper chromatography, Dowex 50 chromatography, or fractional precipitation. (from auth. summary)


The reaction product of diglycerophosphofluoridate and cholestaniase, diglycerophospholipid phosphatase, labelled with \( ^{32}P \), was partially hydrolyzed by papain trypsin, and 2 N HCl or directly with 2 N HCl. Serine phosphoric acid was separated from the hydrolysate in approximately 40% yield (based on phosphorus) by fractionation with Dowex 50 chromatography. Identity was established by comparison with synthetic serine phosphoric acid by fractional alcohol precipitation and Dowex 50 chromatography. (auth. summary)


\( ^{32}P \)-labelled diglycerophosphoryl chymotrypsin was partially hydrolyzed with 2 N HCl at 100°C for 3.5 h. Serine phosphoric acid, phosphoserine, and glycine were released from the hydrolysate by Dowex 50 chromatography. Phosphoserine and glycine, hydrolyzed under the same conditions, was partially converted to glycine and phosphoric acid. Evidence is cited that only phosphoserine (by sequence) and phosphoserine and glycine by sequence is diglycerophosphoryl chymotrypsin. (auth. summary)


\( ^{32}P \)-labelled diglycerophosphoryl chymotrypsin was partially hydrolyzed with 12 N HCl at 12°C for 3 h. Dowex 50 chromatography of the hydrolysate resulted in the separation of (1) phosphoserine, (2) aromatic phosphoamino acid, (3) phosphoserine, (4) serine amino phospholipid, and (5) glycine, amino phospholipid, and glycine. Two other fractions have the same amino acid composition and sequence as peptides (3) and (4), and are believed to be isopeptide derivatives. Asparagine is not a component of these peptides. (auth. summary)


\( ^{32}P \)-labelled Saffin (diglycerophospholipid) was used. Saffin is an enzyme inhibitor similar to that of DPF (diglycerophosphonofluoridate). The diglycerophosphonofluoridate derivative of
trypsin, 4-bromo methylphosphoryl tryptophol, was partially hydrolyzed with 12 N HCl at 37°C for 3 h. 

Data 50 chromatography of the hydrolysate resulted in the separation of (3) methylphosphonolactone, (3) aspartylmethylphosphonylglutamate, (3) methylphosphonolactylglutamate, and (3) aspartylmethylphosphonylglutamate. Another peptide with the same amino acid composition and sequence as peptide (4) was separated and is believed to be its glycoprotein derivative. Asparagine is not a constituent of these peptides.

Wenzelmann and Sabour 1988 - [792]

Diazinon and Related Compounds


The persistence and metabolism of Diazinon, (O, O-diecyethyl O-[3-(4-isopropyl)-4-methyl-5-pyrimidinyl] phosphorodithionate) Dimethoate, Parathion, and Aceethion (O, O-diecyethyl S-carboxyoximethyl phosphonothioate) have been studied in the mouse, American cockroach (Periplaneta americana (L.)), and housefly (Musca domestica L.). The results have been used to explain the selective toxicity of these compounds toward insects as compared with mammals. For Diazinon, selectivity is attributed to high levels of oxygen analogues in susceptible species. For Dimethoate and Aceethion, selectivity is attributed to a persistence of unaltered parent compound in the whole body. Small differences were found in Diazinon absorption and metabolism by normal and Diazinon-resistant house flies.

Methods are quoted for the methods adapted for the preparation of radioactive Dimethoate, Aceethion, Dimethoate and Parathion.


Diazinon may be labelled with C¹⁴, ¹³¹¹, or ¹³¹¹. Since the last offers an easy synthetic route and is more readily measured radiometrically, elemental red phosphorus was selected as a starting material, after irradiating it to a specific activity of approximately 50 mcg. The method of synthesizing phosphorus trichloride is described. The two-step chlorination and the use of the perchloric anhydride were utilized to increase the specific activity and yield of phosphorus trichloride. Paper chromatography analyses of the labelled products were made. Extensive details of the methods employed for the synthesis of phosphorus trichloride, triphosphoryl trichloride, O,Q-diecyethyl chlorophosphates and Diazinon are given.

Mengle and Casida 1960 - [786]


³²P-labeled Diazinon, administered orally to a cow at 25 mg/kg, is rapidly metabolized and excreted. Only low levels of unchanged toxicon were found in blood and milk samples. About 74% of the dose, excreted as polar degradation products, was accounted for in the first 24 h after treatment. (auth.)


The two compounds were separated by inverse partition chromatography. Incorporating the paper with a silicone gelcoat and with ¹⁴C-O-EthOH-NH₂OH as the mobile phase. The spots were detected by spraying with KI or with iodine-NaI reagent (containing 15% dibutyl, 75% KI and 15% NaI) or, with radioactive products, by autoradiography. (CA 50:15044, 1960)


Diazinon was labelled with ²³¹¹. A C₆H₁₄ solution of the anilinic form of 3-isopropyl-4-methyl-6-hydroxy-pyrimidine and ²¹¹NaCl, from the corresponding dichloromethane excess which, with excess NaOH, gives active Diazinon purified by washes with dichloromethane employed as give active dimethylphosphonate was prep. K iodate of the same 6-hydroxy- bis(2-isopropyl-4-methyl-6-pyrimid (CA 60:17058a, 1958)


p²¹¹ is introduced into C₆H₁₄ by ex. out in a Caution tube. The tube is 1 a solution of 2-isopropyl-4-methyl phosphonate more is prepared ²¹¹NaCl, the "radioactive" solution of 2-isopropyl-4-methyl phosphonate after 10 min. (auth.)


Les auteurs décrivent une méthode de préparation de phosphorées et analyse, a cist, à 2-isopropyl-4-méthyl-phosphonate (phosphorées) (A complete abstract may be (Vigne 1960)

Vigne et al. 1957 - [749]

Fisep, J.P.; Tabou, R.L.; PARINE REACTION DECHACHT.

Dans un précédent mémoire (1) on a décomposé 2-isopropyl-4-méthyl-phosphonic de ²¹¹NaCl, préparé à partir certaines de réactions de décalage, nous avons étudié à ce stade le décalage rapide d'hydrogène sulphonique de l'acide.

(1) Vigne 1967


The two compounds were separated by reverse partition chromatography, incorporating the paper with a silicone gelcoat and with ¹⁴C-O-EthOH-NH₂OH as the mobile phase. The spots were detected by spraying with KI or with iodine-NaI reagent (containing 15% dibutyl, 75% KI and 15% NaI) or, with radioactive products, by autoradiography. (CA 50:15044, 1960)

active Diazonin purified by washing with K₂CO₃ solution and an isotropic distribution. Details of the microemulsion employed are given. The product is identified by paper chromatography. The analogous active diethyl phosphate was prepared similarly from [⁳²⁺⁵⁰₇⁺⁵⁰₈]₃⁵Cl⁺. Active Diazonin was also prepared from the K salt of the same 6-hydroxyphosphonate and [²⁵⁺³]Cl⁺, but was contaminated with ethyl bis (2-isopropyl-4-methyl-6-pyrimidyl) phosphonate arising from [³⁵Cl⁺]⁺ present in the [³⁵Cl⁻].

(CA 50: 17289g, 1958)


P²⁵⁺ is introduced into PSCl₂ by exchange at 150°C after by using H₂PO₃⁻. The reaction is carried out in a Carus tube. The tube is then cooled in CO₂ snow-acetone mixture. The PSCl₂ is distilled into a solution of 2-isopropyl-4-methyl-6-hydroxyphosphonate in hexane with a special apparatus. The diethyl phosphorothionate ester is prepared as previously described (CA 50: 17295a, 1958).


Les auteurs évitent une méthode de préparation d'esters complexes des acides phosphoriques et thiono-phosphoriques et son application à la préparation du diéthylphosphate de 2-isopropyl-4 méthyl-6 oxy-pyrimidines et du diéthyl-thio-hydroxyphosphate de 2-isopropyl-4 méthyl-6 oxy-pyrimidines marqués avec P²⁵⁺.

(A comprehensive abstract may be found in CA 50: 14765d, 1956)

(Voir 566)

566 Vigne et al. 1967 - [742]


Dans un précédent mémoire (1) nous avons décrit une méthode de synthèse du P²⁵⁺, diéthylthiophosphonate de 2-isopropyl-4 méthyl-6 hydroxy-6 pyrimidyl, dans laquelle nous introduisons le phosphore marqué sous forme de H₂PO₄⁻₃, préalablement à partir du phospha d'agent radioactif. Cette méthode faisant intervenir un certain nombre de réactions délicates à réaliser sur de tels petits quantités de compôsés volatils et radioactifs, nous avons cherché à trouver la difficulté en établissant 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 contamination.

(1) Voir 567


Les auteurs, définir en doser 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 P²⁵⁺, 2. Une nouvelle technique de chromatographie de partition (chromatographie en phase mi-inverse), afin qu'une série de méthodes sensibles de détection colorimétrique de ce composé, 3. L'identification d'une quantité notable de l'insecticide chimiquement pur, ce qui a permis d'étudier de son activité anticholinestérasique qui n'est révélée importante, 4. L'application de ces deux techniques au dosage dans le lait d'animaux ayant reçu des doses conséquentes de cet insecticide. Vraisemblablement, des résultats n'ont pas échappé à des tests de sensibilité de l'animal en expérience (chèvres).
Dimethoate 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 Dimethoate on and in pea plants showed seven compounds, including Dimethoate, its oxygen analogue, and five hydrolysates produced with phosphoric acid predominating.


Dimethoate (C₂₈H₂₇NO₇, C₂₆H₂₃NO₅), phosphorothioate is known to be effective as a systemic insecticide following foliar application. Analyses made from surface and absorbed residues following foliar treatment of corn, cotton, pea, and potato plants with Dimethoate. The insecticide was rapidly absorbed and decomposed both on the surface and inside the foliage by phosphorothioate oxidation and hydrolysis. Only trace amounts of Dimethoate and its oxygen analogues were present 24 hr after treatment. Of the five identified hydrolysates products, the predominant one from pea tissues was phosphoric acid and from the other plants used as seedlings was C₂₈H₂₇NO₇, 4-carboxydimethyl phosphorothioate on the surface and C₂₆H₂₃NO₅, p-methyl C₂₆H₂₃NO₅, 4-carboxydimethyl phosphorothioate within the leaf tissue. Limited studies were also made on the persistence of the S-ethyl analogue of Dimethoate. (auth.)

An abstract of earlier work was published in Bull. ent. Soc. Amer., 3, 3 (1960) 84, abstr. 83, under "The metabolism and residues of the systemic insecticide Dimethoate in plants."


Dimethoate is active as a systemic insecticide for cattle. These lactating cows were treated orally with the F₁₆-labeled compound. Analysis of blood, tissues, excreta, and milk showed Dimethoate to be rapidly metabolized and excreted. Twelve days after treatment, the insecticide was found in trace amounts only in the cow tissues. Hydrolysis of Dimethoate by rats and cows occurred initially at the methyl-phosphate, phosphate-methyl, sulfur-sulfate, and particularly at the carbonyl-nitrogen bonds. Phosphorothioate oxidation occurred with some of the hydrolysates products and was assumed to occur also with Dimethoate. (auth.)


The metabolism of 14C-Dimethoate was studied following oral and intramuscular administration (10 mg/kg) to cattle. By both routes high metabolism was detected in the blood shortly after administration. The radioactive representing both oral and intramuscular compounds, was observed earlier and dissipated faster in the intramuscular treatment. Chromatographic analysis of blood extracts indicated the presence of both Dimethoate and unknowns, with the latter several times more toxic than the parent compound as determined by enzymic analyses and bioassay. About 87 to 99% of the oral dose was eliminated in the urine at the end of 24 hr. The same percentage of intramuscular dose was excreted after 98. The major metabolites produced were dimethyl phosphate, dimethyl phosphorothioate, and several unknowns. Only 3.7 to 5% of the oral dose and about 1.1% of the intramuscular dose were eliminated in the feces. Analysis of tissues from an orally treated calf showed only very low levels (<0.01 to 0.07 mg/kg of organo-extractable radioactive compounds present in the brain, liver, ovary, and lung. (auth.)

Differens, G., J. toxicol. Environ. Health 1, 6 (1969). Differens or C₂₈H₂₇NO₇ is rapidly degraded to DDVP. The 360 min., and pH 5.6 - 89 h. The R intros to Chlorthalidone by pH 4 to 36% at pH 6.0, 41% Chlorthalidone inhibition. In vivo doses of hematomas feeding on D. 5.4. This, together with the 4 - 5% of P₃-DPVP from the total 3% DDVP is responsible for the in vi

Carter, W., Gorton, W.A. THE PLANTS. J. econ. Ent. 53, 6 (1960). Radiotrophic revealed that th from the soil through the entire r disseminial quantity in the green absorption, the cow, was the co

Details are given of the preparation of P₃-labeled Bayer L13/89 (dimethyl 2,2,2-trichloro-1-(hydroxyethylphosphonate) from radioactive red phosphorous and of labeled DDVP (dimethyl 2,2-dichlorovinylphosphonate) by dephosphorylation of L13/89, and of studies of tissue distribution in last instar nymphs of Periplaneta americana (L.). The compounds were applied in solution in oil to the dorsal cervical membranes, and both were readily absorbed through the integumentary system of Periplaneta americana (L.). The compounds were applied in solution in oil to the dorsal cervical membranes, and both were readily absorbed through the integumentary system of Periplaneta americana (L.).

The rates of oxidative metabolic 2-thioethyll phosphorothioate (1 several plant species using a P₃-
the cockroaches treated with DDVP did not become demonstrably radioactive, and many tissues became only slightly so. After 3 h, much of the radioactivity was concentrated in the heart. 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 haemolymph was probably attributable to the low specific activity of DDVP, the small amount applied to view its high toxicity, and deposition in the tissues. No radioactivity could be removed from outside two hours after treatment. (RAE-B 65: 22-3, 1958)


The insects, called Bayer L13/59, and its derivatives were investigated with $^{32}$P as to metabolism and selective toxicity. The LD$_{50}$ values in flies, cockroaches, cabbage worms and pea aphids varied widely between compounds and species, the acetyl form being generally least and the vinyl most toxic. Antifeedance activity appeared to be caused by dimethyl phosphorlylesters of enzymatically inactive forms. 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. (R: 31; 50695, 1957)


The syntheses and characterization of radioactive ($^{32}$P) Dipterex and Durace are described. Several O. Q-dialkyl 2,3,5-trichloro-1-acytoxyethyl phosphorlyesters and related derivatives were compared as to toxicity and anticholinesterase activity. O. Q-dimethyl 2,3,5-trichloro-1-g-butyloxyethyl phosphonate was the most selectively toxic to houseflies of all the phosphates studied. In vivo and in vitro metabolism studies with insects and man showed that this phosphate was hydrolyzed at the acyl group, the phospho-carbon bond, and possibly the phospho-oxygen-methyl bond. The initial rate of in vivo hydrolysis appeared to be a major factor in the selectivity of the toxin of this compound.


Dipterex of O. Q-dimethyl-1-hydroxy-2,2,2-trichloroethyl phosphonate under mildly alkaline conditions is rapidly degraded to DDVP. The half-life values for this reaction are: pH 8.0 to 8.5 min, pH 7.0 to 5.5 min., and pH 8.0 to 85 h. The rate of reaction is slow at pH 5.4. The in vivo inhibition of housefly cholinesterase by $^{32}$P Dipterex showed marked pfi dependency and ranged from 11% at pH 5.4 to 100% at pH 7.0, thus clearly demonstrating that DDVP formation is necessary for in vivo cholinesterase inhibition. In vivo studies of the mode of action of Dipterex showed that the rate of breakdown of housefly feeding on Dipterex-treated meat was much more rapid at pH 7.0 than pH 5.4. This, together with the 4- to 7-fold greater toxicity of DDVP over Dipterex and the isolation of about 5% of $^{32}$P DDVP from the total $^{32}$P metabolites in Dipterex-poisoned houseflies, strongly indicates that DDVP is responsible for the in vivo toxic action of Dipterex.

2K-Systox


Radioautographs revealed that the radioactive sulfur in $^{32}$P-tagged Bayer 6939 (Di-Systox) is translocated from the soil through the entire pineapple plant. Absorption is greatest in the roots and decreases to barely detectable amounts in the green half-developed fruit. Bioassays revealed that only in the region of greatest absorption, the roots, was the concentration of Bayer 6939 high enough to be toxic to molluscs. (auth.)


The rates of oxidative metabolism and of hydrolytic decomposition of Di-Systox, or O. Q-diethyl S-ethyl-2-chloroethyl phosphodiester (formerly called Bayer 19697) were measured at various temperatures and in several plant species using a $^{32}$P-radiospectrometer. The rates of oxidation of the Di-Systox metabolites in isolated
cotton leaves were accelerated by increased temperatures between 27° and 190°F., and from the Arrhenius energy of activation 10000 cal. per mole it was determined that the rate of oxidation of Di-isoyl sulfide increased about 1.9 times for each 1°C. rise in temperature. Metabolism of Di-isoyl sulfide and hydrolytic decomposition of the toxic products commenced from 2 to 3 times as fast in tomato 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-isoyl at various temperatures and in various species of plants" in Bull. ent. Soc. Amer. 3, 3 (1937) 22, abst. 4)


Using R 2-Di-isoyl, Q 2-dihethyl 5-ethyl-2-monomethylphosphorothioate, the efficiency of plant uptake was measured after soil treatment with various methods of side dressings. The theoretical and practical application of this work will be discussed.

Guthion (Gusathion)


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


"Gusathion" has proved effective against such cotton pests as Anthocidus myrti, Aphis gossypii, Tetanythus bimaculatus, Aphis signifera. In the present studies it was labeled with R 14C, 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 hydrolysate products, R 14C was recovered from the assimilation products of the plant as radioactive phosphopropionate. Seeds which were still immature at the time of spraying contained much more R 14C than mature ones, and much greater quantities of R 14C-labeled phosphothioate could also be precipitated from their oil. No seed contained any traces of radioactivity in their oil after phosphothioate precipitation. No residues were found in the press cakes. "Gusathion" did not have any systemic effect.

Malathion


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 desensitization of Malathion by larvae of a resistant and a susceptible strain of Culex tarsalis. R 14C-labeled samples of Malathion and Acephate were used. A colony of Culex tarsalis, Col. 86 times resistant to Malathion, was found to be resistant to Malathion (Q 1.2-Methyl (ethylcarbonyl) 5.2-dimethyl phosphonothioate), and the diethyl homologue of Malathion (Q 1.2-bis(ethylcarbonyl) ethyl), Q 1.2-diethyl phosphonothioate), although to a lesser degree. Slight resistance to Co-Ral Q 1.2-(2-chloro-4-methylumbelliferyl) Q 1.2-diethyl phosphonothioate) was also observed, but no resistance was found to any other of a series of 14 organophosphate insecticides. Two-to-three-fold resistance to DDT and Dieldrin was also found. Larvae of the resistant and a susceptible colony degenerated Malathion at about the same rate and in the same manner, largely through the formation of carbonylic acid derivatives.

The mechanism by which pre-treatment with EPN (Q-ethyl Q-p-nitrophenyl phenyl-phosphonothionate) increases the subsequent toxicity of Malathion was investigated. P32-labelled Malathion was used. In both the rat and dog EPN resulted in a marked shift in the initial detoxification site of the Malathion molecule from the carboxyesterase to the phospholipase 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 resistance rather than an increased concentration of Malathion in the tissues.


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 thin-layer chromatography. Considerable variation in metabolism was noted with as many as 10 or more water-soluble degradation products found.


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 (Blattella germanica L.), and American cockroach (Periplaneta americana L.), and housefly (Musca domestica L.). Among the insects, Malathion production is correspondingly lower; these effective accounts satisfactorily for the low toxicity of Malathion to the mouse. The low toxicity of topically applied Malathion to the German cockroach is attributable to poor penetration through the cuticle. Technical steps in the preparation of P32-labelled Malathion are discussed.


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 metabolites 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 abstract summary)


The rate of penetration, hydrolysis and phosphonothionate oxidation was studied in vivo for the insects 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.


Homogenates of 11 rat tissues metabolized Malathion at comparable rates, and to similar metabolites. The main hydrolysis occurred at the carboxyesterase linkage. The hydrolysate 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 tissues. The techniques used are described in some detail, also the synthesis of the P32-labelled Malathion used.

136

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

Panathen


In laboratory tests, urine fluid from a cow hydrolyzed 16 organophosphorus insecticides to varying degrees. Malathion and zepp (zephrin, pyrophosphate) were the most susceptible. Oxidation reactions were much less important than reduction reactions in metabolizing the compounds, and phosphorothioates were hydrolyzed much more rapidly than phosphates. The rate of reduction of radioactive Parathion in the urine fluid of a cow that ingested it was similar to that in vitro. Parathion, Paraoxon, and their amino derivatives (O,O-O-diethyl O-P-aminoethyl phosphoroester and phosphorothioate) were found circulating in the blood of the animal and were secreted in small amounts in the milk. Amino-Parathion constituted a major次要 metabolite of Parathion, together with diethyl phosphate and phosphorothioic acids. The toxicological significance of these findings is discussed in relation to the toxicity of the various derivatives. The two amino compounds are much less toxic to houseflies (Musca domestica L.) than than Parathion and Paraoxon. (from abstract summary)


$^{32}$P-labelled Parathion (3 and 6-bromo-nitrophenyl ethyl phosphorothioate (6) and similarly $^{32}$P-labelled specimens were used for stability studies on 16-day. In covered dishes in the dark at 16-18°C the loss of the loss of P is more rapid from I than from II (curve shown), at 40°C in 100 h the I specimen lost over 60% of the P content, while II lost only in 60 h. At lower temperatures the durability is much higher. Thus the appearance of insecticidal action 1-2 after field spraying is not mere evaporation. Similar tests under sunlight (temperature below 8°C) show a rapid loss of P with some 50% being lost after 1 h exposure of I, the rest being lost in 106 h. In diffuse sunlight some 50% loss of P occurred in 2 h; this is comparable to loss of activity from 50% contamination. The loss of I 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 w of weather exposure should not exceed 0.15 mg per kg (applied) (CA 46 (1954) 265)


$^{32}$P-labelled specimens of (PhO)$_2$PS (PhOH$_2$NO$_2$)$_2$ and Et-6-OS (CCl$_2$H$_2$NO$_2$)$_2$ were used in 16-day 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 occur with lower level of the diethyl derivative than more-Et derivative, but this is caused by a more difference of diffusion, since in dead specimen the difference in permeability disappear between females and males.

Chrysophthamum plants were allowed to absorb through the roots aqueous emulsions of the di-ethyl derivative 0.6% to 0.2% and the penetration to the leaves was studied histologically. A spraying with even 0.2% emulsion failed to give complete control of Aulacophora foveicole although the amount of the insecticide which penetrated the plant mass reached 0.008% of the mass at room temperature. This corresponds to 20-30 mg/kg/L. At lower temperature, when the value reached 20 mg/kg/L a considerable degree of control was attained and the insects contained up to 53 mg/kg/L of the diethyl derivative. The penetration into chrysophthamum was substantially like that found in bees. However, on cabbage cultures no control was achieved by this method against Bruxicaebrassivora brassicaceae, although withering of leaves was observed at 0.05% concentration of the emulsion, or higher. In cabbage and chrysophthamum extracts, considerable hydrolysis of the insecticide took place and after 30 d only the hydrolysis product remained; this process is accelerated by sunlight. Dating with 1% dust on shaded kidney beans showed 48% hydrolysis after 16 d; in sunlight almost all was hydrolyzed in 4 dye systems (insecticide, using test...)

Gar, K.A., Klebany, R.Y. RESIDUES AND PHOS IN THE Peaceful Use of Atomic

The authors summarize Russian $^{32}$P and $^{32}$S-labelled Parathion NIEI-101 or O-ethyl O-di or O-diethyl O-(1,2-thesate of NIEI-101 and Carbathion w. and Malathion were about equi... and Malathion were about equi... the latter two were a chitin and methyl Parathion wa. Paper chromatographic studies thion revealed similar decom... toxicity of the insecticide by p. on plants shortly before harvest... Heil, R.L., McFarland, R.J. Soc. 74 (1950) 1686-7.

The insecticide was labelled w. Synthesis progressed via $^{32}$O. Chladn are described.

Igla, A. VERSECHEI MIT RA PHOSPHAT AM GOLDHUMMEL hamates (Menocerus tamius) (monothiophosphat) NATURE.

The absorption and distribution and hibernating hamates. Acts... animals at lower temper. Cumulative dosage effects seen and hibernating animals are de... Jensen, J.A., Darrah, W.F. RADIOACTIVE ISOTOPE TECH

A study on the fate of Parathion Penetration has been made... dodecane. Parathion is also precipitated by ammonium mo...


A very brief description of the ret... activity obtained was 220 µ/r... Xipilani, K.T., Gegenva, G. INTO THE PLANT AND THE E MARKED ATOMS. Microbiol.

Lichstein, E.P. MOVEMENT CONDITIONS. J. soc. Ent.

136
almost all was hydrolyzed in 4 d. On wheat the process takes only 3 d. Thus Parathion is not truly a systemic insecticide, owing to its poor penetration and stability in the plant. (CA 49: 9009g, 1956)

574


The authors summarize Russian research with several radioactive organic phosphorus insecticides including S32P- and S35P-labelled Parathion, methyl Parathion or O-Dimethyl O-p-nitrophenyl thiophosphate, NUIP-101 or O-Dimethyl O-(E)-2-nitropropyl-statusphosphate, S32P-labelled Malathion, and Carbophos or O-Dialkyl O-sulfonylmethyl ester diisopropylphosphate. The photochemical stability of formulations of NUIP-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 NUIP-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 similar; hydrolysis of both compounds proceeds rapidly inside plants. Paper chromatographic studies of alkaline hydrolyses 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.

575


The insecticide was labelled with both S32P and S35P. Phosphorus trichloride was used as starting material. Synthesis progressed via O-Dialkyl O-chloromethylphosphate. The various steps in the experimental procedure are described.

576


The absorption and distribution of S32P-labelled Parathion or its breakdown products were studied in active and inanished hamsters. Artificial "infection" was obtained by injecting insulin and maintaining the animals at lowered temperatures. The lethal dose in active animals was 7-8 mg/kg of body weight. Cumulative dosage effects were observed. The symptoms and characteristics of parathion action in active and inanished animals are described.

577


A study on the fate of Parathion in rabbits treated dermally and intravenously with radioactive S32P-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 salt of Parathion and is absorbed by anion exchange resins, from which it can be regenerated and precipitated by ammonium molybdate. (auth. summary)

578

Jensen, J. A., Pearce, G. W. SYNTHESYS OF RADIOACTIVE PARATHION USING 35S. J. Amer. chem. Soc. 74 (1952) 3184-

A very brief description of the steps in the preparation of 35S-labelled Parathion is given. The specific activity obtained was 220 µc/mM.

579


580

In 1960 a Miami hll lawn and a meadow were treated with Aldrin, Lindane and DDT. Seventeen months later, testing of the soil showed no noticeable difference in the distribution between individual insects, in a vertical sense; Lindane was found to be unevenly 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 field investigations and least noticeable in indoor soil. Under non-leaching conditions, Lindane also moved into the untreated layer, but more was retained in a much soil than in a untreated sand. When radioactive Parathion ($\text{P}_{2}$) was used, it was found that during a period of $\text{P}_{2}$ Parathion moved upward, downward and sideward as well. The results obtained seem to indicate that the movement of Parathion is more rapid in a field than in a soil 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 text. abstr.)

(Earlier work was reported as abstract in Bull. ent. Soc. Amer. 3, 3 (1963) 42, abstr. 56).


Parathion was labelled with $\text{P}_{2}$ and used for determining its uptake by insects, and its ability to penetrate into plants. Cucumber applications were made with a water emulsion of the compound, and amounts of Parathion sufficient to produce mortality were determined with the American moth, *Pteroprepis americana* (L.) and *Drosophila melanogaster*. The penetration of a water emulsion of the radioactive compound into apples was also studied.

582 Lockau, S., Lüdecke, M. **DIE DARSTELLUNG VON RADIOAKTIVEM $\text{P}_{2}$-Q, O-DIAHYDRO-O, Q, P-NITROPHENYL-MONOTHIOPHOSPHAT, SEINE AUFNehmE UND WErTENHtTETTUnG IM INSEKTENTUEB** (The synthesis of $\text{P}_{2}$-O-dihaloyl-o-p-nitrophenyl monothiophosphate, its uptake and distribution in the insect body) *Z. Naturf.* 7b, 3 (1962) 369-377.

The compound is synthesed from radiodine phosphorus via $\text{P}_{2}$ labelled phosphorus on sodiumb. $\text{P}_{2}$-labelled phosphorus isophosphoride and $\text{P}_{2}$-dihaloyl-o-p-nitrophenyl-thiophosphoric acid. After application to the organism, this radioactive phosphoric acid enter penetrates into the body of *Pteroprepis americana* L. and leads to the symptoms typical for Parathion poisoning. The compound is its $\text{P}_{2}$-containing metabolites are distributed differently in the various organs. The head is highly radioactive, probably due to the insoluble 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 3.97 of the compound. The lethal dose is below this value, since part of the poison, on penetration and distribution through the organism may be excreted in the fore-gut intestine, where it may be suffering breakdown or has been broken down previously.


$\text{P}_{2}$-labelled Parathion was applied locally to leaves of *Higueran ovalifollium* Hank and *Punica granatum* (L.) Bio. In the various parts of *Punica granatum* leaves, the poison, parathion, and the stored apple, Parathion was used in a concentration of 0.25% in distilled water. Its absorption and conductivity of that of its decompostion products in these plant tissues was studied by a G-M counter and scintillation photography. The diffusion capacity in terms of $\text{P}_{2}$-labelled compounds was studied.

584 Lüdecke, M. **ÜBER DIE PFLANZEN VON E 605 UND PARMATION E 605 PFLANZE EHR PFLANZE** (On the uptake of E 605 and Parathon by plants and animals) p. 299-261 in "Forstwirtschaft". Eicher, W., F., ed. Berlin, Volk und Gesundheit. 1954, 715p. (In German)

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

585 Mandelbaum, Ya. A., Vlasti, T. **THIOPHOSPHATE AND ETHYL PHOSPHORUS AND THIOCHEMICALS**

Details are given of an autopsy of a young patient (thiophosphates) treated with thiophosphates and ethyl phosphates and thiochemicals. The patient died on 1956.

586 Murray, D. H., Spinks, J. W. **LABELLED PARMATION Q WAS DECOMPOSITION OF A PREVIOUSLY REPORTED DETERMINATION**

The effects of a previously reported determination of thiophosphates and ethyl phosphates and thiochemicals (this was confirmed to 0.2% 0.05% (EGO=PEO), which was (0.5% (EGO=PEO).

587 Sato, T., Tomisawa, C. C. **TECHNOLOGY OF RADIOACTIVE INSECTS**

Tomisawa, C., Sato, T. **INSECTS**. Eisei Kagaku 20

The use of the labelled insects *Pteroprepis americana* and *Drosophila melanogaster* are discussed.

588 Bowman, J. S., Casta, J. E. **THIOCHEMICALS**

Thiomer is metabolized by pla insects used for seed treatment cyclohexyl-methyl phosphonic acid is used as an insecticide and is provided by a $\text{P}_{2}$-labelled compounds as a seed treatment for cotton seeds treated with thiomer and as a seed treatment for treatment of cotton seedlings. The minimal p crops and radioactive thiomer.

589 Bowman, J. S., Casta, J. E. **AND MAMMALS**. J. econ.

The oxidative and hydrolysis with chromatographic and radi (Eco.), alkali and acid, and a hydrolysis products were done are thermodynamic which had led on efficient than been plants which in the extraction products. With a Extreme difficulty was encountered.

(Thiemer had been stability to hydrolysis by algal

590 Bowman, J. S. **METABOLISM OF INSECTS, AND MAMMALS**.

$\text{P}_{2}$-labelled organophosphates articles.

Details are given of a study in which Parathion and O-ethyl (p-nitrophenyl) thiophosphate (NUIP-161) were labeled with $^{32}P$ and $^{35}S$. (Technical details may be found in abstract CA 50: 16564, 1956.)


Labeled Parathion ($p$) was prepared for investigations of insect toxicology. The method used was a modification of a previously reported preparation (CA 43, 1235). Quantitative yields of $^{32}P$-OPC10 were obtained from $^{32}P$-OPC10 and PCl5. The oxophosphorane gave $0.6%$ $^{32}P$-Cl when reduced over carbon monoxide at 1000°; this was converted to $^{32}P$-SCl when heated in a sealed tube with sulfur. $^{32}P$-SCl, with NaCl, gave $86%$ (FP0OPSCl, which with aqueous $p$-OC14H24O1a yielded $86%$ (FP0PC12) (CA 47: 27988, 1955).


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

Phenyl (Thimet)


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 $p$-ethoxy-$p$-nitrophenyl ethylisopropyl phosphorothionate, $p$-diethyl $S$-ethylthiomethylphosphorothionate, and $p$-diethyl $S$-ethylthiomethylphosphorothionate. The last of these metabolites is the most active cholinesterase inhibitor and provides a method of residual action. 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 50 pounds of Thimet per 100 pounds of seed showed less than 0.02 ppm of Thimet or its metabolites in the seeds passing from the treated plants. The residual persistence following seed and foliage application was studied with 6 vegetable crops and radioactive Thimet. (from auth.)


The oxidative and hydrolytic metabolism of Thimet by plants, insects and mammals was further studied with chromatographic and radiometric techniques. Bean plants, northern armyworm (Pectinophora gossypiella) (Cramb.), alfalfa, 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 roots, with armyworms which had fed on these plants, and with the feces of the armyworms. Armyworms were more efficient than bean plants in vivo oxidation of the phosphinonic acid group of Thimet and in hydrolysis of the oxidation products. With the mammals, the excreta products and tissue residues were investigated. Extensive difficulty was encountered in extraction of the radioactive from the tissues of the treated cow and cam (The Thimet had been synthesized with $^{32}P$). The relative insect and mammalian toxicity and stability to hydrolysis by alkaline are reported for Thimet and its oxidation products. (from auth.)


$^{32}P$-labeled organophosphate insecticides were used throughout. The work was published in three articles.
Bowerman, J. S., Cassida, J. E. METABOLISM OF THE SYSTEMIC INSECTICIDE O-D, DIETHYL 3-ETHYL-


Studies conducted to determine the hydrolysis, oxidation, translocation efficiency, persistence, and the degree of binding of phenate, formerly designated as Thimet (O-D, diethyl 3-ethylthiomethyl phosphocholethide) in three soils and quartz sand. Phenate applied as a soil treatment in the field was more available to cabbage and potatoes grown in a sandy soil than in a clay-loam soil as indicated by lower control data and anticholinesterase assay. A measurement of [3H]-labeled phosphate uptake by pea from three soils and quartz sand showed that the largest amounts of toxident were taken from quartz sand and followed by lesser amounts from a sandy soil, clay loam, and muck, in that order. Extraction, column chromatographic and partitioning techniques showed that soil applications of Phenate are partially oxidized, hydrolyzed, and bound to the soil. Chloroform extraction of radioactive from the soils as 7, 14, and 28 days after treatment were identified as Phenate plus a mixture of the phosphocholestarcholates and the phosphocholethanolamines of Phenate. Only a very small amount of the radioactivity extracted from the soils could be identified as hydrolytic products. A large portion of the radioactivity remained bound to the soil and could not be identified. Radioactive Phenate added to quartz sand was rapidly hydrolyzed, but no oxidation products were detected. A study of Phenate volatilization from the soils showed that within an hour after treatment the sandy soil, silt loam, and muck had lost respectively, 20%, 25%, and 10% of the radioactivity applied. However, after this initial loss, very little or no volatilization occurred. Phenate was lost rapidly from quartz sand and a steel surface with less than 10% of the radioactivity remaining 24 h after treatment. (auth.)


Absorption of [3H]-labeled Phenate 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 Phenate additions to the solution.

(Laboratory and field investigations with Phenate-treated Cotton seeds and Phenate accumulation by Cotton plants and recovery from soil.)

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

The uptake of [3H]-labeled Phenate by cotton seeds, following seed treatment, was studied in the laboratory, greenhouse, and field. Data are presented on the effect of removing cotton seed hulls prior to treatment and the effect of temperature on Phenate uptake by cotton seeds.


Tests have shown that systemic insecticides applied to the seeds of cotton, beans and sugar-beet at the time of sowing protected the seeding from attack by a wide range of insects. Studies with radioactive Bayer 1969, Thimet and Monument-5 showed that, after seed treatment, the conidia contained the highest concentration of toxident and that this was not translocated in substantial amounts to other plant parts. The toxident concentration varied 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 concentrations of the different insecticides are discussed, as applied to the various plants and the infesting insects.

Gottschall, P. E., Knack. J. B. PHOSPHORIN INSECTICIDE FED TO COTTON(CultureInfo) PLANTS with 13-labeled carbon resulting from 16O feeding of studies were made with radios tab for the "o" carbon.


The effectiveness of insecticides therefore conducted to determine phosphates in the soil, and its the action of water. The absorption measured by aspido bioassay as used in conjunction with a 


pH3-labelled phenate and pH5, define the degradation media degradation products with the best at different rates in and to recover a monodealkylated the alkaline hydrolysis in this phosphate directly. (auth.)


The role of the alimentary tract transport, metabolism and excretion of the phosphorus-

1.


The synthesis, purification, of pH3-labelled insecticides in the

Papp, P. W., Cassida, J. E. I. BOLIC FATE OF O-D, DIETHYL CLO. L. acric. Food Chem. 1954, 1-D, diethyl O-(C-4,6-methyl phospho-phospho-phosphate bond between and 2 more similar hydroxylic esterage. 1
Chlordimeform, O-ethyl dimethyl phosphorothioate and the related pesticidal organophosphorus compounds are, however, the subject of the present study. The presence of these compounds in the soil, plants, and crops is of particular interest, since they may be degraded by microorganisms to the more toxic parent compound. The objective of the study was to determine the fate of these compounds in a soil-plant system and to evaluate their potential for bioaccumulation in plants and animals.

1. Introduction

2. Materials and Methods

3. Results

4. Discussion

5. Conclusions

References


The effectiveness of insecticide applications to soil often depends upon soil conditions. Experiments were therefore conducted to determine the effect of various soil types upon systemic insecticide absorption by plants from the soil, and the characteristics of soil which hinder the insecticides against the leaching action of water. The absorption of some systemic insecticides by peas from four soils and two sediments was measured by phytotoxicity and anticholinesterase activity. The pea aphid (Macropodophila pistula) was used in conjunction with Thimet® (O,O-diethyl O-(ethylidino)methyl phosphorothioate), Schradan® (dimethyl S-(1-propenyloxy)-3-methyl pyridinium cation), and Phosdrin® (1-methylcarboxymethyl-1-propene-3-yl dimethyl phosphonate, 60% technical). The binding of an insecticide to soil was studied by leaching radioactive Phosdrin through columns of 12 soils. The amount of Phosdrin bound by the various soils correlated in 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.

6. Conclusion

7. Acknowledgments

8. References
phosphorothionate and three derivatives were established for rats. A slower denaturation and excretion of the insecticide metabolites occurred with the cow compared to rats, but the same metabolic pathways was demonstrated for each. $^{32}P$ was used for labelling.


A number of compounds were tested against the “wuchle flies”, Hydopodena lineata (VIII.) and H. boesei (Deg.) in cattle as systemic insecticides, prior to 1945. Experiments with Dow ET-57 in 1956 showed it to cause a high mortality in the larvae of both species when they are encysted in the blad. There was no indication that ET-57, administered orally at 100 mg/kg affected the health of the cattle or mast production. It was slightly toxic at 150 mg/kg, but recovery was rapid. The mean of treated animals was eaten with no ill effect. Two calves dosed with $^{32}P$-labelled ET-57 were found to contain 00 to 7.7 parts per million in the fat at slaughtered after 3 and 14 d, respectively. Limited tests with Bayer 21/130 (O,O-diethyl O-5-bromo-4-benzyloxy-2-methylphosphorothionate) showed that this compound also destroys Hydopodena larvae before they can damage the hide of the hosts and that, unlike ET-57, it does to when applied as a spray. It is concluded that both show promise for the control of Hydopodena but neither can be recommended until more complete toxicological information is available.


Comparative radiocarier experiments were carried out on the chemical oxidation and metabolic metabolism of Dimof (bis(diethylamino)phosphorodiamide fluoride), Schradan and hexamethylyphosphoramide (containing $^{32}P$) in insects, mammal and plants. Their distribution and absorption is discussed. Within insects, plants and mammals, each of the three compounds was oxidized to oxidized derivatives that decomposed on treatment with acid to yield formaldehyde. With all three compounds, one oxidatve derivative was more and another less polar than the original phosphoramide. Except for the greater instability of Dimof and its derivatives, the metabolic intermediates appeared to be similar to those of Schradan and hexamethylyphosphoramide.


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. An account is given of the conditions under which the plants were kept, the procedure adopted at sampling involving 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 rate of the applied Schradan or on the leaves at harvests, are outlined.

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

Solutions of ²²⁴-labelled compound were applied at concentrations between 0.05% and 0.65%. The activity was always below 0.5 µCi/µl. Differences in absorption were observed between plant species, and the effects of some physical factors on the process were monitored. The main translocation is from upper to lower leaves. The absorption of the insecticide is rapid, and absorption is more rapid in broad and runner beans than in chrysanthemum and coltsfoot.


The absorption, translocation, and breakdown of Schradan in plants was studied by means of ²²⁴-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 ²²⁴-labelled Schradan was sprayed on the leaves of apple trees and fieldcabbage, broad and runner beans, coltsfoot, 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. Leaves due to evaporation were lower than expected. Young leaves have been shown to be generally more absorptive than older leaves. Comparisons have 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 equal rates, although the upper surface of this leaf was not stomata. Schradan was decomposed much more rapidly in the bean than in chrysanthemum and coltsfoot.


The toxicity of bis(bismethylamonio) phosphonous monobutyl ²²⁴ labelled was detected against Aphids feeding on broad beans, Sinapis alba leaves on cabbage, and Aeglopsamas on peas with activity equivalent to 10 mg/1. As the radioactivity was washed off in liquid-type extracts after treating plant material with boiling NaCl solutions, the risk of contamination is reduced. The seeds of pea plants quickly absorbed ²²⁴ from cuttage solutions in concentrations which caused aphids to fall from the plant. Culture solutions increased radioactivity; this indicates preferential absorption on non-labile leaf. Absorption of ²²⁴ was more rapid from plant material with higher radioactivity being lost in top and bottom leaves. ²²⁴ concentration of 100 mg/kg plant tissue was lethal to aphids. Translocation of ²²⁴ was observed in leaves of the cabbage, peas, strawberry, hops, and, to a lesser extent, broad beans. Leaves of turnip became radioactive after application of ²²⁴ to the leaf of the parent plant. Radioactive material was not given off by plants absorbing ²²⁴ through the roots. The honey dew of aphids feeding on ²²⁴ treated plants was radioactive. (CA 45: 56481, 1961)
Gardiner, J. E., Kirby, R. A. SOME OBSERVATIONS ON THE PATH OF BISDIMETHYLMETHYLAMINO
A dose of 50 mg/kg of Schradan (Me₂S₅)PO₂.P. PO(OR)₂ was injected into rabbits to death within a few hours with typical symptoms of acetanilid poisoning (excessive salivation, fibrillary twitchings, etc.) as produced by fluorophosphates and other anticholinesterases. However, when the action of this antipal die on cholinesterase is measured in vitro, surprisingly high concentrations are required to produce 50% inhibition, in contrast with other organic phosphorus compounds which are effective at concentrations of the order of 10⁻³ to 10⁻⁴ M. This apparent anomaly was investigated by comparing the effects of the antipal die on rabbit blood cholinesterase activity in vitro and in vivo by means of ³²P-labelled antipal die. The results can be explained by postulating the conversion of the antipal die in vivo into some more active inhibitory compound, the liver being one place where this can occur. The formation of the half molecule, (NMe₂)₂PO(OEt), is excluded as this is inactive.

Gardiner, J. E., Kirby, R. A. ORGANIC PHOSPHORUS INSECTICIDES. PART I. SYNTHESIS OF BIS-
DIMETHYLMETHYLAMINO PHOSPHOROUS ANHYDRIDE CONTAINING ³²P. J. chem. Soc. (1950) 768-78.
A method is described for the conversion of radioactive phosphoric acid into phosphorus chloride on a small scale, and thence through chlorodimethylamino phosphoribipoxide oxide into bisdimethylamino phosphoribipoxide antipal die (cf. preliminary note, Reseach. 2, (1941) 560). The labelled product is suitable for tracer work in plants (where 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.

Gardiner, J. E., Kirby, R. A. BIOCHEMISTRY OF ORGANIC PHOSPHORUS INSECTICIDES I. THE
MAMMALIAN METABOLISM OF BIS (DIMETHYLMETHYLAMINO) PHOSPHOROUS ANHYDRIDE (SCHRADAN), Biochem. J. 51 (1952) 78-85.
A 60% inhibition of whole rabbit blood cholinesterase is caused by incubation for 1 h with 2.8 x 10⁻⁹ M Schradan, bis(dimethylamino) phosphorous antipal die. In spite of this low inhibitor action, injection into rabbits leads to death with the symptoms of acetanilid poisoning. Using radioactive Schradan, it is shown that the compound is converted in vivo into some more active anti-cholinesterase. Incubation of Schradan in vitro with rat or rabbit liver slices leads to a similar enhancement of activity. The active material after liver-slice incubation can be dialysed into buffer and extracted with chloroform; it is labile and is destroyed by 5% exposure to 0.02M Na-alum (authum summary).

Glynn Jones, G. D., Thomas, W. D. E. CONTAMINATION OF NECTAR WITH SYSTEMIC INSECTICIDE
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 weevil 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 honeydew (Sugarc 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 sprays applications of this insecticide on mustard and bean plants does result in contamination of nectar. A series of nectar samples taken over a 4-week period following spraying showed a progressive decrease in total ³²P content and also in the amount of Schradan present in proportion to the decomposability products. The highest figure recorded for the Schradan content of nectar was 22 ppm. Tests on stability of Schradan in contact with the honey stomach of the bee and also in contact with the enzymes invertase, in vitro, 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. (authum summary).

Hardy, G. S., Heath, D. F., Hurme, J. M., Pound, D. W., Whittaker, M. STUDIES ON COMMERCIAL

²³²P was used for preparing Schradan OMPhA was shown to amount of triphenylphosphine and other anticholinesterase as the former but not pentamethyldihydroxide containing 1 compound in biological and anal, and, only dimethyldihydroxide also found in the commercial mix alkaline hydrolys and difference.

The systemic insecticide bis(dimethylamino) was synthesised as ³²P-labelled C by living plants activities of abo, analysis. No preparative details a toxic product originally present a toxic product. Before the following the i on the mechanism of decomposition hyd.
p2 was used for preparing samples in the laboratory. Following the commercial method of preparation, commercial octamethylpyrophosphoramide was added to octamethylpyrophosphoramide, a comparable amount of tritophosphate acid pentamethylamid. This latter compound was apparently as good a systemic insecticide as the former but much less toxic to mammals. A separate synthesis of the tritophosphate acid pentamethylamid containing p2 was carried out in order to study more thoroughly the behaviour of this compound in biological and analytical tests. A smaller amount of tritophosphate acid undimethylamid and minor amounts of pentamethylamid 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(dimethylaminoethylphosphonous) sulfide (octamethylpyrophosphoramide) was synthesized as p2-labelled OMPA. In order to study the chemical fate of the substance on its uptake by living plants activities of about 400 µg/mg were used in order to obtain the necessary sensitivity in analysis. No pre-treatment details are given in this paper. Within 4 weeks of spraying only about 10% of the toxic product originally present absorbed by the plant material unchanged; up to 80% is present as decomposition products. By following the fate of hexamethylenetetramine p2 it is possible to throw some light on the mechanism of decomposition in the plant. It is probably entirely different from that of inactivated hydrolys.


Two plants of sugarcane, sugar beet, hops, and beans were sprayed at various times from May to October with radioactive material containing approximately equal proportions of the systemic insecticide octamethylpyrophosphoramide and its higher homologue, tritophosphate acid undimethylamid. On analysing the sprayed crops at various times after spraying, it was found that the concentration of both compounds in the plant fell at much the same rate, and that this rate varied little among the plant species treated providing all were treated at the same time of year. The rate of the lower species of plant was as the year progressed from May to September became very slow in October. It was shown that the plants decomposed the insecticide compounds and that the lowering of insecticidal concentration with time was probably due largely to decompositions within the plant.


Sugar beet and strawberry plants were treated with octamethylphosphoramide and orthophosphoric acid undimethylamid and sodium polyphosphate oxide, both labelled with p2. Both compounds were decomposed at similar rates in the two species of plant. When sugar beet plants treated with the first compound were analysed 10 to 14 days after treatment, it was shown that the p2 in the beet was only about 20% of that present in the untreated plants and that the second compound was not detectable. The results obtained in this paper confirm the findings of previous workers that the tritophosphate acid undimethylamid is converted into the active substance and that the tritophosphate acid undimethylamid is not an active substance in the beet.

Stoker, M. STUDIES ON COMMERCIAL OCTAMETHYLPYROPHOSPHORAMIDE AND ANALYSIS. J. Sci. Food Agric. 3 (1952) 69-78.

The fate of the systemic insecticides and allied compounds after spraying on foliage was studied using p2 as a trace element in them. The results show that, under certain conditions, a very high proportion of the applied material may evaporate without there being time for it to be absorbed. Some crop plants absorb bis(dimethylaminoethylphosphonous) sulfide and bis(hexamethylenetetramine) compounds 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 with a theory of absorption through a semi-permeable membrane. The rate is very sensitive to incident radiation, both
visible and irritating, 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)


Oxamethylylphosphoramidothioate (Schranad) containing radioactive 32P was degraded in white clover (Trifolium repens), tansy, Braunbearms open seeds, and French beans; lepamethylylphosphoroxime, a powerful anticholinesterase (probably ethyl cyanomethyl phosphorothioate or oxamethylylphosphoroxime oxido), and labile derivatives were produced. Organogenised rice, oats, and cotton produced the same products in similar proportions. Tansy degraded the dimethylamido, mono- methylamido, dimethylamido, isopropylamido, and ethylamido phosphorothioate, and lepamethylylphosphoroxime oxido. The dimethylamido was demethylated to its monomethylylphosphoroxime oxido, in the other compounds only the dimethylamido groups were attacked. O,O-Diethyl O-ethylidithiophosphorothioate was converted by plants into at least 5 compounds soluble in CHCl3 and of unknown structure. O,O-Diethyldithiol phosphorofluoridate was oxidized in plants rapidly to O,O-Diethyl O-ethylidithiophosphorofluoridate and another compound of unknown structure; H2O2 produced the same products, 32 references. (CA 50: 61088, 1959)


It was desirable to develop a new technique, dependent on microdistillation, for separating the insecticides 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 Schranad added to untreated crop 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 be generally applicable also to determination of residues of other toxic plant extracts or volatilities similar to or greater than that of Schranad. It is possible to determine the 32P-labeled octamethylphosphate and any phosphorus compounds derived therefrom through various operations, regardless of the large amount of natural phosphorus 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 25 references on Schranad. Mention is made of the synthesis of 32P-labeled Schranad and its metabolism in the rabbit following injection.


32P-labeled Schranad and tetracaine, organic insecticides, were synthesized and used in studies of spray residues and of their metabolism in the plant. Residues were measured at 0.01 ppm and fell between 0.07 and 0.07 ppm on trees, roots, and potatoes after 4 weeks. After 41 days cotton seed oil contained 104 ppm Schranad while the seed cake contained 10 ppm of non-toxic metabolites produced, which were separated from the insecticide by volatile partition. Autoradiographs showed deposition in orange peel and cotton seeds. Metabolic products were separated by counter-current distribution and by chromatography on treated filter paper. (BA 20: 22831, 1959)


32P-labeled OMMA was employed in order to study its behavior in citrus plants, particularly in the lemon, Citrus limon (L.) Bur., the sour orange, C. aurantium L., and the Valencia orange, C. sinensis (L.) Osbeck. Technical details of the materials and methods used are given. The absorption of the labeled insecticide and H2O2 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 39% of the activity was found in the basal leaves on a gpm basis, 47% in the medium leaves, and 30% in the terminal leaves. Over a 26-day period, the distribution was: basal leaves 19%, median 22%, terminal 69%. Absorption and translocation of OMMA following application to base, leaves and peel are discussed. Lethal dosage levels and greenhouse trials (biological and/or synthetic materials) of OMMA in orange and for citrus Experiment Station, River}

Metcalf, R.L., Faltus, T.R., & CUSTOMER PRODUCTS. J.L. 32P-labeled Schranad was sprayed onto citrus leaves, seeds, and Schranad had a strong effect on yield. Upon rejoining, this was even further enhanced, and not only the lowchlorophyll-in, but also the leaves of systemic insecticides.

Metcalf, P.J., Tree, B., & TISSUES TO ITS TOXICITY TO I.


625 Steinh, D.L., Alper, T., & ANTHOCYANINS IN GROUNDNUT (PL 1958)

An aphid (Clulceps sp.) is known to eat plants in the Triniad, but to the "mesotes". Tamer-labeled C12 to study the translocation of the fr was taken immediately after feeding, and the total radioactivity was due to loss of OMA as a whole and further loss took place by times of OMA until more than 11 days steadily with time.


Following application of Schranad surfaces of broad bean and Colomn, main leaves absorbed more than 5 by 5 processes - evaporation, transpiration. The leaves were effectively removed from the to other parts of the plant occurred I appeared to be translocated in it to kill a aphid feeding elsewhere or
THE EFFECT OF SYSTEMIC INSECTICIDAL GROWTH REGULATORS ON THE BEHAVIOUR OF SCHNABERD IN PLANTS. A SURVEY OF RESULTS OBTAINED WITH 14C-LABELED SCHNABERD AND DEMETRON-S.  


Following application of Schnaberd to leaves, some was absorbed and remained. While the two surfaces of broad bean and Colocynth leaves were equally absorptive, the lower surface of apple and parsley leaves absorbed more than their upper surface. Application of Demetron-S100 to leaves was followed by 5 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 14C from treated leaves to other parts of the plant occurred, mainly in an upward direction and in amounts sufficient to kill aphids. It appeared to be translocated in the phloem. Translocation of leaves treated with it was never sufficient to kill aphids feeding elsewhere on the plant. Species differences were found in the rate of breakdown of the compound.
after absorption from leaves. The primary derivatives of II were retained for several weeks, especially within treated leaves. Following root application to broad beans in sand or soil, unchanged II was absorbed and detected in the shoot tip where concentrations of II 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 root of bean plants (Phaseolus vulgaris). After uptake it moved through the stem at approximately 5% cm/hr, 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 leaves, both in stem and leaf tissues. The P-containing compounds detected in the plant were toxic to insects, as determined by bioassay using the two-spotted spider mite, *Tetranychus urticae*. Two breakdown products of OMPA were found after 8 d. (Also published as ACU-2134, California. Univ., Riverside. Citrus Experiment Station 26 p.)

Articles of the same title were also published in *Circ. Leav* 29 (1960) 93, 94, and in the *Calif. Citro* 28 (1960) 138, 140, 142. It was concluded that leaf-spraying or injection into the stem might be better methods of applying OMPA.

Syntox (Demenet)


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 fruit treated at flowering with Syntox tagged with P showed measurable radioactivity 8 d after treatment, with a progressive decrease during this period of time. The insecticide was found to be concentrated in the readily growing young tissue.


The labelled sulphur is apparently on the phosphorus in the Syntox, O-2-thiocarbonyl-O-2-(ethylmercapto)-ethyl phosphates. Among the studies carried out with this insecticide are translocation experiments, seed treatments, volatilization studies, vapor pressure studies, and phototoxicity studies.


The two insecticides, Demeton-O and Demeton-S occur as a mixture in the commercial insecticide Syntox, and act on *Aphis fabae* Scop, as contact and systemic insecticides and as fumigants. When prepared in the experiments described, as a contact fumigant or systemically 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 P, it was shown that, when applied to the root, 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 capillary 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 tapeout 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 larvae were transferred from older to younger leaves of broad beans, usually in sufficient quantities to kill aphids, but the results were more consistent with Demeton-S. The quantity translocated downwards was small. A low level of Demeton-S was found at root after treatment reduced the quantity of Demeton-S translocated. There was also a reduction in younger to older leaves of broad beans, usually in sufficient quantities to kill aphids, but the results were more consistent with Demeton-S. The quantity translocated downwards was small. A low level of Demeton-S was found at root after treatment reduced the quantity of Demeton-S translocated. There was also a reduction in younger to older leaves of broad beans, usually in sufficient quantities to kill aphids, but the results were more consistent with Demeton-S. The quantity translocated downwards was small. A low level of Demeton-S was found at root after treatment reduced the quantity of Demeton-S translocated.

In this fifth paper of a series, n O-2-thiocarbonyl-2-0-(ethylmercapto) pyridine in the fumigant species of p products, in order to confirm th applied to the bases of young c isolated by the method that on plants 4-6 d after application we (the thiophosphates, suberized, the spectrum from the mixture O-2-thiocarbonyl-2-(ethylmercapto) than the core (1957)
isomers gave off toxic vapours, and plants treated through the roots gave off toxic vapours from the foliage. (R.A.E. 45: 911, 1957)


C14-Systox and phosphate analogues were synthesized from 2-ethylmercaptoethyl-1,2-C14-thio ethyl mercaptan and 2-ethylmercapto-1,2-C14-thiophosphate. Isotopic isolation of C14-systox gave isomers. Sulfonamides and sulfides of the ethylmercaptoethyl and sulfides of the isomers were prepared by dephosphonate oxidation and characterized by paper chromatography. Systox in the cockroach is converted to sulfonamide and polar compounds.


The rearrangement of 2-ethylmercaptoethyl diethyl thiophosphate to its isomer 2-ethylmercaptoethyl diethyl thiophosphate has been investigated using labeled phosphate and paper chromatography and found to show first-order kinetics. The effect of solvents also has been investigated. Ethyl alcohol drastically increases the isomerization rate, chloroform to a lesser degree, while ethyl acetate, diacetate, methyl ethyl ketone, benzene, and 2,4,6-trimethylpentane have little or no effect. (Auth.)

Preparative details are given.


The toxic oxidation products of the thiono and thiol isomers, O2-diethyl O-ethyl-2-sulfophenylthio phoshothionate (thiophosphate sulfone), O2-diethyl S-ethyl-2-sulfonethylphosphorothionate (thiosulfone sulfate), O2-diethyl O-ethyl-2-mercaptoethyl phosphorothionate (phosphate), O2-diethyl O-ethyl-2-sulfonethylphosphorothionate (phosphate sulfone), O2-diethyl O-ethyl-2-sulfophenylthio phosphorothionate (thiophosphate sulfide), O2-diethyl O-ethyl-2-mercaptoethylphosphorothionate (thiophosphate sulfide), and O2-diethyl O-ethyl-2-sulfonethylphosphorothionate (thiophosphate sulfide) have been synthesized and some of their properties were compared with the metabolic products of the Systox isomer 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 sulfone, which is then converted to the thiophosphate sulfide 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 thioephosphate sulfide and then passed to the thiophosphate sulfone. NO-labeled O2-diethyl O-ethyl-2-mercaptoethyl phosphorothionate and O2-diethyl O-ethyl-2-mercaptoethyl phosphorothionate were used. Textile tests were made on Metacricotuber auri (Mec.) Rehder, Bactrocera homoeontica (Bolh.), Manicam domesticus L., Tetanybus melanocephalus (Kru.) and Aphid voyseyi Chao. (Includes auth. summary.)


In this fifth paper of a series, an account is given of further investigations on the chemical behaviour of O2-diethyl S-ethyl (ethylthio) phosphorothionate (Desmost-S), 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. Desmost-S labelled with 14C was applied to the base 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 is the plant 4-14C after application was identical with O2-diethyl S-ethyl (ethylthio) phosphorothionate (the thiophosphate sulfone). When this compound labelled with 14C was applied to plants in the same way, the spectrum from the metabolite isolated after two weeks proved that subsequent oxidation of O2-diethyl S-ethyl (ethylthio) phosphorothionate (the thiophosphate sulfone) occurs at a somewhat lower rate than the conversion of Desmost-S to the thiophosphate sulfinate. (R.A.E. 45: 131, 1957)
The 14C-labelled isomers were located to the leaves in amount (9).

The growing areas of the upper leaf topological application to the stems was fast for Demeton-S as in bean and lemon leaves by pest studies in which changes were d 3-5 times as toxic as Demeton caused total mortality at an effective dose of about 300 μg/g. In Demeton-S, the principal isomer was recovered from the leaves of pla.

**References**


---

The 14C-labelled isomers were located to the leaves in amount (9).

The growing areas of the upper leaf topological application to the stems was fast for Demeton-S as in bean and lemon leaves by pest studies in which changes were d 3-5 times as toxic as Demeton caused total mortality at an effective dose of about 300 μg/g. In Demeton-S, the principal isomer was recovered from the leaves of pla.

**References**

The ¹⁸³-labelled isomers were readily absorbed by the root and stems of the lemon seedlings and translocated to the leaves in amounts toxic to *Parasitica* or *Orthotaenia* and *Helicoverpa* (both). The translocated materials were present in greatest quantity in the peripheral growing areas of the upper leaves, and the systemic behaviour closely resembled that of *Schraden*. After topical application to the stems, radioactivity accumulated in the upper leaves of beans and lemon 4-10 times as fast for Demeton-S as for 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 residues in which oranges were dipped in standard solutions and the dry residue tested showed that Demeton-S is 3-5 times as toxic as Demeton-O to P. citri and H. armillata, and the metabolism of the latter was at least 100 times as rapid. Pure Demeton-O was a poor inhibitor of hydroxyl choline oxidase, but Demeton-S and the principal metabolites of both isomers were highly active. No radioactive vapors were recovered from the leaves of plants of which the stems had been treated with the radioactive isomers.

(RAF-A 45; 811, 1965)


The systemic behaviour of Demeton-S and its methosulphone and sulfoxide (O₂,4-dimethyl-2-sulfinyl-ethyl phosphorothioate) applied topically to the stems of young cotton plants was studied by means of ^14C radioactivity and paper chromatography. Demeton-S was absorbed and translocated much more rapidly than the sulfoxide for up to 7 days after application. At 48 h, the amount was nearly equal, and at 7 days the sulfoxide was present in appreciably greater amounts. The methosulphone accumulated much more slowly, indicating a lower degree of penetration of this strongly polar compound through the plant cortex. The rates of metabolism and decomposition of Demeton-S and its sulfoxide were approximately the same, and small amounts of the sulfoxide were formed from both. Radioautography after topical application to young tomato leaves showed that the penetration and spread in the leaf interior was most rapid for Demeton-S and least so for its metabolites, but more rapid for O₂,4-dimethyl-2-(sulfinyl-ethyl) phosphorothioate (Demeton-O) than for Demeton-S sulfoxide. (from auth. summary)


The investigations were largely carried out by means of radiolabelled styxos isomers, O₂,4-dimethyl-2-sulfinyl-ethyl phosphorothioate (thiono isomer) and O₂,4-dimethyl-2-sulfinyl-ethyl phosphorodithioate (thiod isomer), and paper chromatography. Samples of apples, peach, oranges, walnuts, potatoes, and sugar beets were processed for analysis. The metabolism of the isomers and their residues produced, and the action of air and sunlight upon surface residues are discussed. In addition to activation within the plant tissues to oxidative metabolites, these are subsequently hydrolyzed to nontoxic, dialkyl phosphatides and nontoxic, dialkyl phosphatides and alcohol. The third isomer metabolites persist in tests and fruits about twice as long as the thiono isomer metabolites. The hydrolysis of the toxic metabolites in plant materials to nontoxic phosphatides derivatives is a further safeguard against the retention of toxic materials over a long period of time. Average residue values of toxic styxos metabolites 2 and 4 weeks after application were substantially below 0.1 ppm, i.e., so low that they could not have been determined precisely by other methods.


The translocation of O₂,4-dimethyl 3-S-(diethylamino)ethyl phosphorothioate (thio isomer) and its salts, particularly the hydroxamic acid, in plants was investigated by the use of compounds labelled with ^¹³³I and compared, in some cases, with that of its thiono isomer O₂,4-dimethyl 3-S-(diethylamino)ethyl phosphorodithioate and Demeton-S (O₂,4-dimethyl 3-S-(diethylamino)ethyl phosphorothioate). Cotton, bean, and orange plants were used in experiments and the distribution and metabolism of thio isomer and its salts were discussed. (from RAF-A 45, 51; 182-3; 1958)


The chemical behaviour of methylstyxos, O₂,4-dimethyl 3-S-(diethylamino)ethyl phosphorothioate, methylstyxos phosphorothioic acid and methylstyxos-sulfone was examined in the plant in the mammalian...
organisms by means of 32P-labelled compounds. Two radioisotopic transformation products were found in the plant. In addition to sulphonyl, methylisopropylthioleum was also identified in plants treated with methylisopropylthioleum. Both methylisopropylthioleum and its oxidation products, sulphone and sulphate, are exposed to the normal hydrolytic decomposition of non-toxic compounds in the living plant. The first decomposition product is dimethyl phosphoric acid, the end product methylethyl phosphoric acid. It could be proved that the phosphoric acid formed by complete decomposition of the "sulphone" active substance is largely used by the plant for the synthesis of phosphates (particularly phosphoric). True residual values were found considerably below those calculated at random on the basis of the total 32P-content. The sulphone primarily formed in the plant is secreted 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 harvested crop.

645
A 0.05% Drenchy spray was used in which the chlo isomeric of Demeton, Demeto-5, was labelled with 32P, and used in a determination of the distribution of residues in tobacco and potatoes at various times after application. A soil application of 0.05% at the rate of 2 g/ft2 resulted in 566.6 to 465.9 ppm in tobacco leaves 84 days later, and 17.6 ppm in leaves in potatoes.

646
Sprays were used where the Drenchy ingredients were present in their normal proportion but the Demento-S was labelled with 32P. The method of spraying and sampling is applied to tobacco and potato plants as described, and was also used to determine how much of the imidicetole is of its more toxic degradation parts present in potatoes and tobacco at various times after treatment (cf. Stein and Smith, 1954). The CHCl3 extract which contains the toxic portion of Drenchy degradation products was found to be 0 ppm (dry weight) in tobacco leaves and 1.2 ppm (wet weight) in potato taken 84 days after soil applications of 0.05% at the rate of 2 g/ft2.

648
The systemic immiscible Drenchy normally contains a mixture of the two isomers, diethyl 2-(ethoxyethyl) ethyl phosphoramide and diethyl 2-(ethylphosphoramide), or Demento-5 and Demento-6, respectively. Demento-5 is toxic to honey bees, and sublethal amounts may possibly be transported in nectar by them and contaminate the honey. Demento-5 has been shown to be about ten times toxic 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. Demento-5 was used. The rate of Demento-5 in white mustard (Bomarea rubra), horseradish (Armoracia officinalis), and field beans (Vicia faba) was followed over several weeks by means of the radioactive tracer technique. Radioscopy of nectar samples from flowers that opened a few days after spraying showed no unchanged Demento-5, but degradation products were present in small amounts. The highest value for total radioactive found in the nectar corresponds to 0.7 parts per million expressed as Demento-5. Radioscopy of treated leaves and new nectar over several weeks after spraying confirmed that Demento-5 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 a considerable quantity of the two primary degradation products are retained by treated leaves for several weeks after spraying. Chrysanthemum which had absorbed an extract of them proved toxic to Macrosiphum (Macrosiphum) rosae (Rich.). It is concluded that the nectar to which Demento-5 is in the nectar is negligible, but that some contamination by degradation products, possibly toxic to man, occurs. (R.A.E 43; 405, 1958)

649
Following leaf application of diethyl 2-(6-hydroxyethyl) ethyl phosphoramide (Demento-S), labelled with 32P, to beans, apples, and colostrum, breakdown into toxic non-volatile compounds, and absorption occurred concurrently and effectively removed unchanged 32P from the leaf surface within a few hours. Improvement gave rise to absorption. It is deduced that 32P is absorbed by the apple as 32P-phytosflavin, which is more firmly fixed in leaves than other tissues. A brief note is added to an untitled paper. Whereas the previous idea was that the leaves normally sprayed with 32P-label show that fruit and vegetables which are sprayed with a plant growth regulator also contain 32P-label.

650
Tiets, H. "METASACTOXY" residues. [Hofafon. Wiss. 5] A brief note is added to an untitled paper. Whereas the previous idea was that the leaves normally sprayed with 32P-label show that fruit and vegetables which are sprayed with a plant growth regulator also contain 32P-label.

651
Tiebs, H. BIER MIT 32P MARKIERTEN PFLANZEN UND DEN NEBENWIRKUNGEN DES CHLORPHENIRAMIDOPS. (Hofafon. Wiss. 5) A brief note is added to an untitled paper. Whereas the previous idea was that the leaves normally sprayed with 32P-label show that fruit and vegetables which are sprayed with a plant growth regulator also contain 32P-label.

652
Tiebs, H. METABOLISM DES PHENYLPHOSPHORAMIDOPS (Demenhot-S) 0. Le Metabolisme des Sulfur-containing compounds in the living plant. A brief note is added to an untitled paper. Whereas the previous idea was that the leaves normally sprayed with 32P-label show that fruit and vegetables which are sprayed with a plant growth regulator also contain 32P-label.

653
Bosch, C. C., Fernando, H. E., FRATESI, J. J. Proc. Roy. Soc. 145, 3 TEPP (termedly phosphatase) ethyl (β-galactosidase) phopho. radiobiological assays. A brief note is added to an untitled paper. Whereas the previous idea was that the leaves normally sprayed with 32P-label show that fruit and vegetables which are sprayed with a plant growth regulator also contain 32P-label.
Antidote products were found in the plant. In plants treated with phentoxypyrin, some of these are exposed to the naturally occurring phentoxypyrin, which phentoxypyrin was not significantly higher in the plant than in the leaves. The following root application to bean plants in soil or sand, aphids feeding on the shoot tips were killed after 3 d; unchanged I was translocated following root application. I and its toxic derivatives appeared to move much more freely in systems than in phytomass tissue. (CA 50 (6) 795, 1960)


A brief note is added to an earlier communication (Tiedt and Tietz, 1956, p. 2 and 3). Whereas the previous study described data under conditions designed to obtain maximum residue, normal sprays were applied at a rate of 28, 280, 0 and 410, 0 ppm.


E 1092 (the active substance of systox) was labelled with 3H (supplied by G. Schütz, Farbenfabriken Bayer) and applied to roots of 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 detoxification by plants were studied. The insecticide was absorbed freely from solution by the intact root. The quality of treated soil was found to influence absorption and concentration limits. The permeability of the root for water increased over a long period, then dropped below the original value, and finally adjusted to it. After absorption by the root, the insecticide was translocated to shoot organs above the ground. Temporary storage, particularly peripherally, was observed in leaves. Spraying or brushing of the leaf with sylphon solution allowed greater forward penetration, the degree depending on several factors. Treatment of individual leaves resulted in a displacement towards untreated parts of the plant, particularly apically. 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. The plant appeared chieffly through exudation via cuticle pores, translocation after treatment of the shoot above the ground primarily via the phloem. Evaporation or rain removes the eliminated toxic parts from the surface.


Le méthylures ou mélange de méthylure est transformé en composés toxiques conformément aux observations de health. Les sulfonylures et les sulfoxides des matériaux actifs, du "Systox" sont identiques aux dérivés D.C. et C.B.

On a pu prouver que les acides phosphoriques finals de la décomposition complète de la matière active ne transitent dans une large mesure en phosphorates végétaux (contenu en éthylène). Le sulfonylure que se produit en premier lieu dans la plante est éliminé quantitativement au seuil de la gamme de quarante-six heures à la chaleur. En cas d'observation aiguë chez le souris blanche, 97% du sulfonylure sont éliminés (15 h). II en résulte que l'absorption de faibles quantités du produit comme p. e. des résidus se manifeste dans les produits de recollage ne peut conduire à des intoxications chroniques.


Le méthylures ou mélange de méthylure est transformé en composés toxiques conformément aux observations de health. Les sulfonylures et les sulfoxides des matériaux actifs, du "Systox" sont identiques aux dérivés D.C. et C.B.

On a pu prouver que les acides phosphoriques finals de la décomposition complète de la matière active ne transitent dans une large mesure en phosphorates végétaux (contenu en éthylène). Le sulfonylure que se produit en premier lieu dans la plante est éliminé quantitativement au seuil de la gamme de quarante-six heures à la chaleur. En cas d'observation aiguë chez le souris blanche, 97% du sulfonylure sont éliminés (15 h). II en résulte que l'absorption de faibles quantités du produit comme p. e. des résidus se manifeste dans les produits de recollage ne peut conduire à des intoxications chroniques.


Le méthylures ou mélange de méthylure est transformé en composés toxiques conformément aux observations de health. Les sulfonylures et les sulfoxides des matériaux actifs, du "Systox" sont identiques aux dérivés D.C. et C.B.

On a pu prouver que les acides phosphoriques finals de la décomposition complète de la matière active ne transitent dans une large mesure en phosphorates végétaux (contenu en éthylène). Le sulfonylure que se produit en premier lieu dans la plante est éliminé quantitativement au seuil de la gamme de quarante-six heures à la chaleur. En cas d'observation aiguë chez le souris blanche, 97% du sulfonylure sont éliminés (15 h). II en résulte que l'absorption de faibles quantités du produit comme p. e. des résidus se manifeste dans les produits de recollage ne peut conduire à des intoxications chroniques.
of radioactive material to the core gut of surviving than of posthatch connectives, and higher concentrations in the muscles of posthatch than of surviving ones. Although no radioactive materials were detected in the central nervous system, the authors do not consider that this necessity 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 P-labeled tetraethyl pyrophosphate (TEP) is described. The corresponding specific activity of the product is 65 mc/μg, but this could be increased by altering the ratio of active to inactive P and no major modification of the technique would be required. The over-all chemical yield based on H₃PO₄ is 49%. (CA 48: 938a, 1958)


Insects were exposed to the vapor phase of the P-labeled 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 by the insects 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.


The insecticide (Bayer 2614) was studied with regard to its chemical stability to heat, hydrolysis, and oxidation and to the effect of the products formed upon insect toxicity. The compound is readily oxidized to the sulfone and upon heating undergoes internal oxidation-reduction to also form the sulfide. Additionally, the compound spontaneously hydrolizes very readily to form the 4-ethyl-thion.


The above insecticide (Bayer 2614, an ethyl analogue, and several reduced and oxidized derivatives were investigated as contact and systemic insecticides. The most active compound studied was of the same order of contact toxicity as fumonilone and was also effective systemic insecticides. In plant tissues, the sulfides are oxidized to sulfones and also appear to isomerize to 4-ethyl-isou bases. Compounds p-CH₃SO₂H₂O₅S (C₆H₄) and p-CH₃SO₂H₃O₅S (C₆H₄) were available in highly purified and in P-labeled preparations. Experiments were carried out on Macrosiphum luteum, Myzus persicae (L.). Nematoljus cinctus (McGregor), Tribolium confusum (Duv), Lepidoptera puparia (I. E. Smith) and Nematoljus crustaceae (L.), and contact toxicity of p-substituted phenyl dialkyl phosphorothionate and phosphates determined. Results on contact toxicity, systemic toxicity, rates of absorption and translocation are discussed.


Some phosphorothionates show reluctance of organisms to to the hydrolysis water. It was found that the P-amides, but is extremely stable and is broken by water at the same, and all the mono P-labeled form of R₂NCO₁ w


The biological distribution on 1-propan-2-yl phosphate, was noted for frequently high losses currently available, compound to produce the effective agent organic-phosphates studied on. Accumulation seemed to occur in cereals and nerve cord of the κ


1-D, short residual systemic insecticidal compound 3486 consists of about 30 to insects and mammals. Deep residue was negligible attack on both insects within the of the vinyl phosphonate, 3P loss in less than 4 and over 8 resides in crop plants treated following insecticide application different techniques, amongst (auth.)


Some phosphorothionates show reluctance to the hydrolysis water. It was found that the P-amides, but is extremely stable and is broken by water at the same, and all the mono P-labeled form of R₂NCO₁ w


The rates of hydrolysis in alkaline R' are alkoxy- or alkylamino- The mechanism is of type S₂
From preliminary screening of 14 systemic compounds with cacao seedlings in Costa Rica, Thilans, Chapman, and Dittmar were selected for further study. These five systems were compared on the basis of their movement and persistence in the foliar parts of mature cacao trees after single implantation. Their effect on the growth of chocolate-producing from beans from the treated trees, and the level and nature of residues in the beans using ultra-violet and ultraviolet-near methods of analysis. Thilans and Chapman 1960 were readily translocated into the foliar portions of the 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 of the trees in relation to the site of implantation. Studies with radioactive 1960 (labelled with $^{31}P$) demonstrated a high concentration of phosphorus-containing residues in the cotyledons of the cacao beans but these residues did not partition into chloroplasts and did not inhibit chloroplasts, and therefore cannot be considered as 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 RHC was used as a foliar spray. (auth.)


569 The biological distribution and fate of the cis isomer of compound 2046, $Q, Q$-dimethyl-1-carboxy-1-propan-2-yl phosphate, was studied after being labelled with $^{31}P$. Enzymatic and ultraviolet-phosphates are noted for their high specific activity. It was found that in contrast to other systemic insecticides currently available, compound 2046 does not require a systemic "metabolic activation" within the plant to produce the effective insecticide. The substituted-vinyl phosphates had the strongest residual period of 20 organo-phosphates studied on cotton, 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 caecum and nerve cord of the moth, Peridessa americana.


566 $Q, Q$-dimethyl-1-carboxy-1-propan-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 $\frac{1}{4}$ cis and $\frac{3}{4}$ 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 isomer. The initial enzymatic attack on both isomers within the plant appeared to be on the carboxylic ester group, followed by hydrolysis of the vinyl phosphate bond. Foliage application to vegetable crops in the field resulted in a 99% residual loss in less than 24 hours and over 99% loss in 4 days based on anticholinesterase determinations. The toxic 2046-residues in crop plants treated at dosage levels used for insect control were essentially dissipated within 2 days following insecticide application. The residual properties of compound 2046 were determined by several different techniques, amongst them radiative insecticide, using $^{31}P$ as tracer. Its synthesis is described. (auth.)


501 Some phosphonamides show measurable toxic properties to mammals and insects. The study was undertaken to measure the hydrolysis rates of some dimethylamides of phosphoric acid in acids, alkaloids and water. It was found that the $P-N$ bond is almost as easily broken by acids as the $C-N$ bond in organic amides. It is extremely stable to acids. Only in acid amides, containing the group $\cdot P-OH$, is the $P-N$ bond 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, $^{31}P$-labelled form of $\text{H}_{2}P\text{O}_{3}$ was used in the study. (auth.)


502 The rates of hydrolysis, in alkaline solution, of the compounds of the type $R(P(O)(X)X)$, where $R$ and $X$ are allyloxy- or alkylaminoxy-groups and $X$ is an acidic group, are summarised, and results are given. The mechanism is of type $S_{N}$. The electronic and inductive effects of substituents are usually very
similar to those found in carbon chemistry for reactions of this type. However, ethyl \( \text{H}_{2}\text{C} = \text{CH}-\text{CH} \text{==CH} \text{CH}_2 \text{OH} \) phosphonium ylide and compounds containing an \( \text{H}_2\text{C} = \text{CH} \text{==CH}_2 \) or \( \text{H}_2\text{C} = \text{CH} \text{==CH} \text{CH}_2 \text{OH} \) bond are hydrolyzed exceptionally rapidly, perhaps because the cyano group and the sulphur atom are very readily polarized relatively to the other substituents considered. In the phosphorodiamic acid fluoride series, those compounds containing four alkyl substituents are hydrolyzed markedly more slowly than those containing only three, owing to a steric effect. For the same reason, diester \( \text{H}_2\text{C} = \text{CH} \text{==CH} \text{CH}_2 \text{OH} \) phosphonates in aqueous and alcoholic solutions would be expected to be more stable.

All rates of reaction in neutral solution and several of the lower ones in alkaline solution were determined on compounds labelled with \(^{31} \text{P} \) or \(^{32} \text{P} \). 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 hydrolytically cleaved phosphorus can be neglected. Hydrolysis rates were obtained using very dilute solutions of \(^{31} \text{P} \)-labelled compounds. Salts catalyse hydrolysis of \(^{31} \text{P} \)-disopyrophosphates and \(^{31} \text{P} \)-dimethylphosphoramidite fluoride. \( \text{P} \), for the first compound is probably composite, water acting as both an anion and a cationoid reagent. Generally, however, water acts as an anion by an Sp3 mechanism. Substituents have similar effects to those described in Part I, except that in the extra-alkyl diphenylphosphate some effects are more important than inductive effects, and that in some instances the rates are less in neutral than in alkaline solution.


(T. in Hawaii)


The nature of the products formed by in vitro and in vivo hydrolysis of Parathion, methylyl Parathion, Diazinon, Dow ET-97, Chloroxon, and Dehypon was studied. All three dialkylaryl phosphates were hydrolyzed at both the alkyl-phosphate and the aryl-phosphate bonds. Alkyl-phosphate hydrolysis was proportionately greater with the dimethyl than with the diisopropylphosphates in rat 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 rat may contribute to the lower relative toxicity of the dimethylaryl phosphates to mammals. Differences were also noted in the rate of oxidation of the various hydrolytic metabolites between rats and cockroaches. The phosphonotrichic insecticides (Dow ET-97, Chloroxon, methylyl Parathion, Parathion, and Diazinon) used in the study were synthesized from \(^{31} \text{P} \) phosphonofluoride prepared by isotope exchange. Subsequent treatments are described. (From author.)

II - E Pyrethrins and related Compounds

666 Aresco, F. J., Baben, P. R. SEPARATION OF \(^{31} \text{P} \) FROM \(^{32} \text{P} \)-LABELLED AND \(^{32} \text{P} \)-UNLABELLED CYTISANTHENIC ACID ON PAPER. Science 130 (1959) 848-9.

\(^{31} \text{P} \)-labelled \(^{31} \text{P} \)-unlabelled - Allenithin has been synthesized. The procedure for a successful paper separation of the \(^{31} \text{P} \)-form from the \(^{31} \text{P} \)-unlabelled cytisanthenic acid is described. A comparison of the 8 isotopic labelled Allenithin was of interest. Some attempts were made to analyze certain zones of impurities also obtained, but parent compounds do not permit an interpretation of their nature and origin.


Radioactive Allenithin has been synthesized to facilitate a study of the metabolite fate of radioactive amygdamone acid after their application to houseflies and cockroaches. After having been purified by chromatography, the radioactive Allenithin appeared to be approximately 98% pure. (sufh. summary)


'There are five contaminants we to ammonium oxalate was (4) to ammonium bicarbonate, and a third fraction was (5) to ammonium bicarbonate, and a third fraction was, and a third fraction was, and a third fraction was.'
Traces of five components were found in the reversed-phase chromatogram of C14-Allethin with respect to ammonical ethanol: one (A) at Rf 0.0 and a mixture of four (C) at Rf 0.8. This mixture, with respect to ammoniacal Mopsophyl acetate, consisted of an unknown D at Rf 0.0, both di-est and tans-2-C14-chrysanthemumic acid, and a mixture at Rf 0.8. The last mixture consisted, with respect to ammoniacal Tannhydrol B, of an unknown E at Rf 0.0 and demethyl allethrin at Rf 0.8. At present, the most logical explanation for the presence of chrysanthemumic acid and demethyl allethrin is that traces of Allethin are hydrolyzed during reversed-phase chromatography by the ammoniacal solvent. However, these products may be produced by some other reaction, such as photo-decomposition, because some A and C also have been observed on chromatograms prepared in the absence of ammonia.


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 30% of C14 were used. The symptoms of poisoning manifested by pyrethrum-treated cockroaches were correlated with the concentration of a toxin in the hemolymph as determined by bioassay. The concentration of a toxin in the hemolymph was correlated with the concentration of a toxin in the hemolymph as determined by bioassay. The concentration of a toxin in the hemolymph was correlated with the concentration of a toxin in the hemolymph as determined by bioassay.


Allethin (I) labelled with C14 was incubated with anise oil extract of homogenates or it was injected into adult houseflies. After a metabolism period any unchanged I and its metabolites were extracted, resolved, and determined radiochemically. A considerable fraction of I 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 I metabolized by a male lipase extract and a female abdomen homogenate were small and of doubtful significance. Metabolism of I by female thoracic homogenates could not be detected. A stabile extract inhibited the metabolism of I. There was some evidence that benzamidine, a lipase inhibitor, reduced the metabolism of I in vitro at the higher concentrations used. Absorption of labeled I-C14 was rapid during the 1st 5-10 h after application. The fraction of the dose absorbed in 3 h approached 90% after 48 h but fell off significantly at higher doses. (CA 51:1697g, 1957)

**671** Baskin, N. W. MODE OF ACTION OF PERICYANIL BUTOXIDE AS A SYNGNOSIS FOR PYRETHRUM. Ph.D. Thesis, Illinois, Univ., Urbana, 1952. The following insects were used in these experiments: a normal, or non-resistant strain of houseflies, Musca domestica L., a pyrethrin-piperonyl butoxide-resistant strain of houseflies; adult flesh flies, Sarcophaga carnaria, and adult American cockroaches, Periplaneta americana L. When piperonyl butoxide and Allethin in the ratio of 1:1 are applied to the housefly there is a resistant slight decrease in the rate of Allethin penetration and initial lag in knock-down time. C14-labelled pyrethrin and oxalic acid were used to test this observation. In general, the various experiments showed that piperonyl butoxide reduces the rate of desorption of pyrethrin and insecticidal in vitro.


The fate of pyrethrum insecticide in female DDT-resistant houseflies (Musca domestica L.) has been studied, using Allethin labelled with C14 on the chrysanthemum monoacrylonitrile acid moiety. To study the

Young pyrethrum plants having numerous buds were grown for 12 d in an atmosphere containing 0.5 µg of C\textsubscript{4}H\textsubscript{4}O\textsubscript{4}H total C. The brine from the flowers was strongly radioactive. (CA 62: 8445a, 1969)


Pyrethrum is obtained from pyrethrum flowers (Chrysanthemum cinerescensfolium). Although the plants will grow in any part of the world, the flower contains an appreciable amount of pyrethrum only when cultivated at high altitudes with temperate climates. Pyrethrum is substances of strong insecticidal actions but are completely non-toxic to warm-blooded animals and to man. The use of pyrethrum as insecticides is growing since insects develop no resistance to pyrethrum as they do to synthetic insecticides. The preparation of radioactive pyrethrum extract is reported following exposure of plants to an atmosphere containing carbon dioxide labeled with C\textsubscript{14}. (BA 13: 8537, 1959)


A method is described for obtaining radioactive pyrethrum by growing pyrethrum plants (Chrysanthemum cinerescensfolium) for a prolonged period in an atmosphere containing radioactive carbon dioxide (C\textsubscript{4}H\textsubscript{4}O\textsubscript{4}H) and isolating and purifying the pyrethrum from the C\textsubscript{14}-labeled flowers. A mixture of C\textsubscript{4}H\textsubscript{4}O\textsubscript{4}H and normal carbon dioxide (C\textsubscript{4}H\textsubscript{4}O\textsubscript{4}H\textsubscript{2}) was generated from a mixture of radioactive and normal barium carbonates (BaC\textsubscript{4}O\textsubscript{4}H\textsubscript{2} and BaC\textsubscript{4}O\textsubscript{4}H\textsubscript{2}) and their utilization by the plant described. The method is given in some detail. About 400 mg pure pyrethrum were extracted from the flowers. Tests showed that the pyrethrum had the expected insecticidal activity against houseflies (Musca domestica L.) and cockroaches, and that they were labeled with C\textsubscript{14} in both alcohol and acid portions of the molecules at levels high enough for qualitative and quantitative determinations. Detailed observations made throughout the work, precautions taken, and improvements that could be made in the method are discussed. (From SAE-A 662 349, 1969)


As an aid to study of the mode of action of pyrethronyl butoxide, a pyrethrum synergist, radioactive pyrethronyl butoxide was prepared. A study was made of the absorption and excretion of radioactive pyrethronyl butoxide after its topical application to the ventral thoracic area of male adult specimens of Leucophaea mediterranea (F.). About 89% was absorbed in 3 d. About half the radioactivity in the applied dose was recovered from the faeces in 7 d. Paper chromatographic analysis of faecal extracts showed that less than half of the radioactivity was from pyrethronyl butoxide, the remainder consisted of unidentified, water-soluble metabolites. The internal distribution of radioactivity in female cockroaches showed that the brain and thoracic ganglia, fem-gut, and 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, fem-gut, and hind-gut and Malpighian tubules are involved in the breakdown of radioactive pyrethronyl butoxide in females of L. mediterranea. (From aich. summary)

(An abstract of this paper was published in Iowa State Coll. J. Sci. 22, 2 (1967) 159-60. See also Bull. ent. Soc. Amer. 2, 9 (1968) 17. abstr. 23)


F - F Nicotin


Isotopically labelled nicotine w. The nicotine iodized had a sp. 1-10 mg/kg of C\textsubscript{14}-labeled nicotine no prolonged storage of nicotinic expired air.

Bowden, K. ROGENESIS OF N
Abstract of doctoral thesis. See also Schmidt and Dahn, 1958.


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 unsuitable to their further decomposition after extraction from insect tissues, e.g. on multidimensional paper chromatograms to which they could be assayed radiochemically by scanning techniques. The method of reversed phase paper chromatography developed for the separation of bionine analogues of DIDT and its derivatives was found to be applicable, with minor modifications.


A mixture of (biologically synthesized) C14-labelled pyrethrins was resolved by reverse-phase paper chromatography into chrysanthemic and pyrethric esters, and unidentified non-insecticidal impurities. Animal, labelled with C14 in the alcohol portion of the molecule, was exposed on the milligram scale at 170 mg/g of pure ester and purified by means of reverse-phase paper chromatography. Animal, the natural mixture of pyrethrins, or the chrysanthemic ester separated chromatographically was injected into or applied topically to adult houseflies. After a metabolism period the unchanged ester and their metabolites were extracted, resolved by paper chromatography and determined by radioactivity assay. Significant and comparable fractions of all the applied pyrethrins were metabolized to relatively non-insecticidal substances within 24 h. When the symplex pipertoxin cyclomistic was applied simultaneously with the pyrethroid, the metabolism was substantially inhibited, but not completely, in the case of aldrin. Absorption of the pyrethroids applied topically was almost complete within 24 h and was apparently non-selective from an applied mixture of esters. The presence of pipertoxin cyclomistic inevitably retarded absorption in 24 h, presumably by dilution of the pyrethroids on the insect integument. (From auth. summary)


The tissue distribution and metabolism of C14-labelled pyrethrin and cinerin in the American cockroach, Periplaneta americana (L.), were determined in male and female roaches, and the data summarised 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 cinerin to C14O following administration to both sexes by several routes. The highest percentage of excreted C14O (measured as H214CO3) occurred after intraperitoneal perfusion. Results are presented as tabular and graphs. A large portion of the radioactive pyrethrin and cinerin may be taken to have undergone hydrolysis in the insect corresponding to keto-alcohols and cyclosphyllary acids, plus unchanged esters, and several unidentified metabolites. Eight to 12% of the radioactivity was excreted as C14O2.

(Also published as AECU-2441, Kansas Agricultural experimental Station, 43 p.)

II - F Nicotine, Carbamates and other Compounds


Isotopically labelled nicotine was obtained from tobacco plants grown in an atmosphere containing C14O2. The nicotine isolated had a specific activity of 0.187 mg/mg. After the intravenous injection of 1.10 mg/kg of C14-labelled nicotine into dogs, 96% appeared in the urine within 24 h. These appear to have been metabolized to nicotine, etc. metabolites in body tissues. No radioactivity was detected in the expired air.

682 Bowden, K., BIOGENESIS OF NICOTINE. Nature 179 (1956) 768.
Dr. Tryphon Evangeliou, containing C^{14} in the 9-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 suggesting that nicotine in the transplanted leaf is converted into nicotine.


Recent experiments with C^{14} have established that the methyl carbon of methionine can act as a precursor of the nicotine methyl carbon in intact 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 methylation to nicotine. (auth.)


Recent studies with C^{14} showed that the methyl carbon of choline can be transferred to give the methyl group of nicotine in N. rustica. The methyl carbon 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 50 tobacco plants, 3 months old, was fed 1.3 x 10^{-6} mole of glycine labelled with C^{14} in the alpha-carbon and having a radioactivity of 1.0 x 10^{-6} cpm. After the desired feeding period, the plants were dried and nicotine isolated from them as the diacetate. From a group of plants sampled glycine for 10 days, nicotine diacetate having a specific activity of 1.1 x 10^{-6} cpm/mum was obtained whereas another group of plants to which glycine was fed for 7 days yielded nicotine diacetate with a specific activity of 8.5 x 10^{-6} cpm/mum. The nicotine from both groups of plants was demethylated using hydrochloric 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 methanolic hydriodic acid to give methylbutylmethylamine iodide which was counted for radioactivity. About 75% of the radioactivity of the nicotine from plants fed glycine for 10 days was recovered in the quaternary iodide whereas the nicotine from plants fed glycine for 7 days yielded about 100% of the radioactive carbon on demethylation. Glycine labelled with C^{14} in the carboxyl 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 N-methyl carbon may arise by transmethylation from methionine or by reduction of either formate or the alpha-carbon 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 the 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 (exceptwise) been regarded as a possible precursor of the pyridine moiety of the nicotiana alkaloids. An attempt was devised for checking on the availability of nicotinic acid and its ethyl ester as precursors for nicotine biosynthesis. Carboxyl-labelled nicotinic acid was prepared from 9-hydroxypteridine.
m-butylluminum and c^{14}O_2, giving an activity of 3.38 pC/mg C. Ethyl-C^{14} nicotine with a radioactivity of about 0.1 pC/mg C was also prepared. Tobacco roots (Nicotiana tabacum, var. ‘Turkish’) were grown in culture and in due course given aqueous solutions of the acid or of its ether. A table gives data on nicotine from C^{14} feeding experiments. The negligible activity of the carbonate samples indicates that neither nicotine acid nor its ethyl ether had been incorporated into nicotine during the culture period. The results are discussed. It appears that whatever the relationship between nicotine acid and nicotine in the living plant it is confined to the catabolic side of metabolism and is unconsidered with nicotine biosynthesis.


Ring-labelled ^{14}C and c^{14}C nicotine acids were prepared by recrystallizations accompanying the isolation of nicotine. These acids were applied to sterile excised root cultures of Turkish tobacco. The nicotine produced by these cultures contained c^{14}C and ^{14}C in significant ranges of specific activity. Degradation experiments demonstrated that the isotopes were confined to the pyridine ring of nicotine. Nicotine is thus produced from nicotine acid and ornithine (data of Byers et al. and of Lees). Specifically labelled nicotine acids were employed to clarify details of the pathway of nicotine acid utilization.


Ring-labelled T-nicotinic acid and nicotine acid containing c^{14}C in both ring and carbonyl positions were supplied to sterile cultures of excised root of Turkish tobacco. Substantial amounts of radioactivity were found in the nicotine produced by the roots during their growth. Oxidation of the T-labelled nicotine with MnO_4 or KMnO_4 indicated almost complete recovery of the T from the nicotine to the nicotine acid. Conclusion: the pyridine ring of nicotine acid is the biosynthetic precursor of the pyridine ring of nicotine and related alkaloids. (CA 50:134474, 1958)


The four specific ring hydrogen-labelled nicotine acids were prepared and fed to tobacco root cultures in sterile media, then the nicotine produced by the roots was isolated and analyzed. Recrystallization and carbon-14 labelled nicotine acid was similarly employed. The nicotine from all of these except nicotine acid-6-t showed substantial incorporation into the nicotine. Oxidation of nicotine acid, obtained from the nicotine, to the corresponding 2- and 6-pyridines indicate that the position of hydrogen label is conserved during the conversion to nicotine. The 6-labelled acid gave less than 1% of the amount of incorporation shown by the other acids, indicating the probability of enzymatic attack on the 6-position of nicotine acid during its conversion to nicotine by the tobacco roots. The conversion probably does not proceed via carboxylation at the 6-position, since both 6-hydroxynicotinic acid-6^{14}C and 1-methyl-6-oxy-nicotinamide-2-t failed to be incorporated. The possibility that the acid is incorporated into nicotine via a 1,6-dihydro intermediates is being investigated. Nicotinamide is incorporated to at least as great an extent as is the corresponding labelled acid. (publ.) (IRA 14:10618, 1959)


The author discusses the tobacco alkaloids, biosynthetic intermediates, the rate stability of alkaloid production and the possibility of the rate-limiting steps, the dependency of nicotine production rate upon growth rate, and possible botanical correlation. Ring-labelled nicotine acid-2^{14}C and 2^{18}F and specifically synthesized nicotine acid-2^{14}C were supplied to cocultures (‘Turkish variety’ and R. plena), and radioactivity was found to be incorporated to different degrees into nicotine and anabasine. This and other results indicate that nicotine and anabasine, respectively, may be synthesized in the plant from the universal metabolites nicotine acid and ornithine, and nicotine acid and tyrosine. Nicotine acid may undergo some modification prior to reaction with the corresponding amino acid derivative. There is no indication in these experiments of the nature of the circumstances which compel the plant to synthesize apparently identical products from such metabolically related intermediates.

261
The metabolism of pyrene-2-C\(^{14}\) in Nicotiana glauca has been studied. It was radiocative. Systematic degradation radioactivity resided in the \(\alpha\)-carbon signification of these results is discussed.

Lecce, E., Siegrfried, K. J. THE BIODEGRADATION OF NICOTINE IN 4493-31.

Radiocative nicotine was isolated for two and three weeks after the administration experiments had almost the same level nicotine had occurred during the last months was degraded unambiguously being between the two \(\alpha\)-carbons of the pyrene.


Nicotiana tabacum plants were grown to the roots of the plant. The activity increased. When glucuronic acid-5-C to the plant, radiocative nicotine was expected. In experiments showed that all the acetate incorporation of nicotine, pectin and 6.0078%, respectively. The title.

Tocchio, K. BIOGENESIS OF NICOTINE (1989) 524-58. (In P - Isolated root cultures of tobacco involved in the biosynthesis and the results are compared with those pre).


The compound was absorbed through desiccating carbon of absorption. Absorption through root was greater.


Topical application of C\(^{14}\)-Selin ric and paper chromatography, at least 9 hours. Susceptible and resistant was.


A study of the absorption of nicotine from this chemical to soil. By use of \(\times\) from EPT\(^{14}\)-S among crops.
The metabolism of phenyl-4-C\(^{14}\) in 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 (C\(^{14}\)-phenyl)-phenol) indicated that all the radioactivity resided in the \(a\)-carbon atom of the phenol ring attached to the phenol 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 ochtamine-4-C\(^{14}\). The nicotine from the two experiments had almost the same specific activity, indicating that little or no metabolic breakdown of ochtamine had occurred during the last two weeks of the second experiment. The nicotine from both experiments was degraded unspecifically and all the activity in the alkaloid was shown to be equally divided between the two \(c\)-carbon of the pyrrolidine ring. (auth.)


Nicotiana tabacum plants were grown for varying lengths of time up to 9 weeks after feeding ochtamine-4-C\(^{14}\) to the roots of the plant. The activity of the nicotine reached a maximum after 3 weeks and then slowly decreased. When glutamic acid-\(a\)-C\(^{14}\), uniformly labelled phenyl-4-C\(^{14}\), and anabolosine-4-C\(^{14}\) 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 ochtamine, phenylalanine, phenylalanine, and glutamic acid into nicotine was 0.40, 0.12, 0.262, and 0.607%, respectively. The significance of these results is discussed. (CA 52: 13083a, 1959)


Treated root cultures of tobacco were fed with compounds labelled with C\(^{14}\). Chemical transformations involved in the biosynthesis and degradation of nicotine were studied. Reaction mechanisms are discussed. Results are compared with those previously reported. (NSA 11; 5851, 1961)

Carbohydrates


The compound was absorbed through the cut surface of leaves, cut surfaces of root, and intact roots (at descending order of absorption rate). Intact leaf surfaces did not absorb it in appreciable amounts. The absorption through roots was greater in corn plants than in oat plants. (CA 62: 7908h, 1954)


Topical application of C\(^{14}\)-Sevin resulted 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 EDTC by crops in pre-emergence application indicated an uptake of this chemical from soil. By use of a radiochromatic technique the differences in accumulation patterns of \(b\)-EDTC among crops were demonstrated; above-ground portions of beans, peas, and corn
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-labelled material is described to provide a tool for these studies at normal dose levels. (auth.)

Other Compounds


Newly emerged flies were placed on standard corn meal-molasses food to which tracer amounts of 3H and 2,4-dinitrophenol (DNP, 0.008 M, 0.008 M and 0.014 M) were added. Females were dissected after varying intervals; the amount of radioactivity taken up by various tissues was determined. Initially, most of the phosphorus is found in the gut and haemolymph; 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, ovarian, ovary-fed DNP seem to mature more slowly than ovaries from controls. Upon being removed from labelled food, control females exceed 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.


Acetate labelled with C14 in position one (CH3 C14COOH), in both was used as a precursor of S-Oxone. It could be shown that no carbon atoms are incorporated in S-Oxone in barley plants, that the acetate can be administrated by means of foliar absorption, and that the method described is an easy way of preparing radioactive hemicone.


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 initial stimulation followed by depression, and a still higher one which gave principally profound depression. With all concentrations of DNP phosphorylation was completely hydrolyzed and the concentration of adenosine 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 higher 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 particulate fractions. 3H was used as tracer element throughout. (from auth.)

Turnell, F. M. PHYSIOLOGICAL EFFECTS OF ELEMENTAL SULFUR DUST ON CITRUS FRUITS. Plant Physiol. 22 (1947) 13-22.

Rate of volatilization of elemental S increased logarithmically with temperature. S dusted on orange fruit penetrated the peel to a depth of 250 μ when the fruit was incubated 6 h at 15.6°C. The release of gases, and specifically of H2S and SO2 under different conditions (aerobic, anaerobic), while incubated at different temperatures is discussed. Gaslase of the peel was inactivated by dust treatment and incubation. S-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.

712 Turrell, F. M., Chevers, M. LEADEN AS AN INSECTICIDE. When lemon fruit is dusted with the S in the H2S formed to dew two such provided large a source within the plant. Elan, produced by topical dual. The or which vaporization occurs and the lemon suggests that the S has be


A study was made of the effects of adult Drosophila melanogaster on the incorporation of 3H. 0.001 M DNP is 1 x 10-7 M DNP/wet male and female flies; the results reduce the rate at which exocytosis is performed. Cytoplasmic tubules, wings, a block exogenous phosphorus uptake. Conclusion of incorporation is a the fact that DNP-treated females of control females incorporate 50% as much. Per unit weight the and thioacetate. It was found that the phosphorus entering the heart 1950.


W2-phosphatase was used as a control. Blood and hemolymph from scaring, from the same blood. The enzyme was not less than 50% of their previous phosphorus capacities due to blood loss have been depressed. (cont.)

716 Green, M. SYNTHESIS OF CAR REPELLENT. J. econ. Ent. 51.

For studies of the various proper repellent, this compound was provided. For combing carbonic m-hydrogen chloride was then combined. Activity was 6.7 x 104 distincten.

When lemon fruit is dusted with sulfur containing 35 S and incubated (41 °C) for 68 h, a large proportion of the 35 S in the H2SO3 formed is derived from the 35 S applied. The sulfur formed in the fruit peel can also be derived similarly provided large amounts of 35 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 35 S produced is influenced by the area of the S-layers from which vaporization occurs and the duration of the exposure at 41 °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 dimethylphosphonate upon viability, growth, and phosphorus incorporation by adult *Dichopelma melanogaster*. Results are tabulated and presented graphically. Data are included on the incorporation of phosphorus into phospholipids. 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 to male and female flies is 1 x 10^-9 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 haeomelophy, thorax, head, leg, gut, and abdominal regions. DNP acts specifically on the ovaries to completely block exogenous phosphorus uptake after an exogenous P-concentration 30% the control value is reached. Cessation of 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 ovaries of control females incorporate 1.7 times as much exogenous phosphorus as the ovaries of control males in a 20 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 75-85% of the phosphorus entering the haeomelophyte withdrawn rapidly by the various tissues. ([From BA 26: 29574, 1859])

II - G Repellents

**Dicycloxylamine**


p35P-phosphate acid was used as a tracer in experiments with *Aedes aegypti* (L.) feeding through a membrane on citrated blood. When dicycloxylamine was present in the blood at a concentration that prevented the mosquito from engorging, the mosquitoes barely touched the membrane and did not inject their probosces 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 probosces into the blood but did not imbibe. It was concluded that most of the repellency was due to vapour action, but that a low concentration contact chemoreceptor on the labels may have been involved. (auth.)


For studies of the various properties of H+ diethyl-m-toluamide, an outstanding all-purpose insect repellent, this compound was prepared in radioactive form. The molecule was labelled in the carboxyl position by carbonating m-toluic magnesium bromide with C6H5O2 to give C6H5-m-toluate acid. The m-toluate acid chloride was then combined with diethylamide to give the final product, of which the specific activity was 6.7 x 10^-4 disintegrations per second per gram. (auth.)


(For detailed abstract, see CA 44: 5056b, 1955)
Little information is available as to why certain compounds act as insect repellents, and why they are effective for such short periods of time. Dimethyl phthalate labelled with C^14 was applied to the skin of guinea pigs at 0.97 - 7.11 mg/lb. After 6 h, 0.06 - 0.98 mg/mg/lb had been lost by evaporation and 1.52 - 5.40 mg/mg/lb 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, dimethyl phthalate as such was not found in the urine. Only 0.7% of the absorbed dose was excreted in the faeces during 8 d, whereas 98% appeared in the urine. Very small amounts of radioactivity were found in the blood, skin, and hair. (From ref.)

(An abstract of earlier work was published in Bull. ent. Soc. Amer., 4, 3 (1955), abstr. 188.)

Dimethyl Phthalate


C^14-labelled dimethyl phthalate was prepared by treating p-Mec_2H_4MgH with C^14O_2 (obtained from Boc^14O_2), oxidizing the resulting p-toluic acid to phthalic acid, and condensing by the acid-phthalic method. The overall yield, calculated on Boc^14O_2, was 80.4% (CA 49:7185c, 1955).


The retention of NA, MA, and dimethyl phthalate (D) on the skin in various emulsion bases was studied under three experimental conditions (normol, exposure to a fine spray of Na^2O, and conditions of similar perspiration with radioactive tracer techniques). Under normal conditions, an oil/water base gave better retention for NA and MA than a water/oil base, but the reverse held true when the bases were subjected to fine H_2O spraying. Under conditions of perspiration, NA was retained well in water/oil base but MA 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 for containing 10% of acetone/NA was evaluated and found superior to 7 other bases. (CA 48:16164c, 1955)

II - H Insecticide Metabolism in

II - H 1 INSECTS

Survey


Review article dealing with resistance to DDT, Propan, Dieldrin, BHC, organophosphorus insecticides, pyrethrum, cyanide, and arsenic. 229 references. Work with radionuclides 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 hydrocarbons is divided into DDT metabolism in houseflies, DDT-dehydrolactone of resistant houseflies, synergism for DDT-resistant flies, DDT metabolism in houseflies other than houseflies, hexachlorocyclohexane (BHC) metabolism in houseflies, and insect metabolism of cyclodiene insecticides. A shorter section deals with pyrethroids and miscellaneous insecticides. Organophosphate insecticides are discussed in terms of their oxidation reactions, reactions other than oxidation and phosphorylation or alkylation hydrolysis, phosphorylation and alkyl phosphate hydrolysis, their selectivity in relation to the metabolism of organophosphate insecticides and acquired resistance to them. Relevant work with radionuclides is cited throughout.


Some of the advances in insecticide metabolism are indicated. (18 refs.)


The complexity of selective fat oxidizing and amino acid metabolism insect by the injection of acephalic considering the biochemical cell under different conditions must develop. Resistance, phys mechanism of insecticide and

Warrington, P. W. Biodi (1957) 92-166.

(Presented at the Seminar on "I, 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 insecticides and of their enzymatic detoxification, and of knowledge gained concerning the metabolism of both resistant and susceptible insects.

722 Metcalfe, C. L. PHYSIOLOGICAL BASIS FOR INSECT RESISTANCE TO INSECTICIDES. Physiol. Rev. 35 (1955) 297-325.

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.

+ Metcalfe 1955 - [413]
+ O'Brien 1959 - [509]
+ Perry 1958 - [459]
+ Perry 1960 - [401]


Review article with 72 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, oxidation reactions, such as conversion of dimethoate to phosphate esters and oxidation of thiophosphates to sulfoxides and sulfones, and oxidation of phosphonamidate to more potent cholinesterase inhibitors. Detoxifying processes may convert insecticide to non-toxic 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 cockroach, M. domestica, boils, etc., whereas the process follows four or five metabolic pathways. Many of these reactions are enzymatically catalyzed. Work with radioisotopes is discussed in connection with C14, C13 and P32-labelled Dieldrin, a P32 analogue of Dieldrin, C14-labelled Dieldrin, Pyrethrin, Aldrin and labelled C14, C13 and P32-labelled Malathion, Dipel, DDVP and Dalon.

+ Winteringham and Baran 1965 - [443]


The complexity of selective insecticidal action and biochemical selectivity is reviewed. Glycolysis, oxidative and anaerobic acid metabolism in insects and mammals, the metabolism of acetate (fused in the insect by the injection of C14-C14), 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.


(Presented at the Seminar on "The Resistant of Insects to Insecticides" New Delhi, India Feb. 27-March 7, 1968)
A 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. (92 references, including numerous refs. on application of radioisotopes)

Akris and Maclain

Chang and Kame 1969 - [434]

Winteringham and Harrison 1969 - [430], [437]

**Bayer 22408**


**Bioc**

Bradbury et al. 1963 - [440]

Bradbury and Standen 1965 - [441]

**Biocide**


Bradbury 1967 - [430]

**Blen"**

Bradbury and Standen 1968 - [444]

Bridge 1969 - [448]

Pottosin and Gotta 1968 - [455]

Chlorobenzene

Greaves and Smith 1960 - [457], [458]

Kamil and Smith 1960 - [458]

**Co-Fal**

Vickers and Arthur 1960 - [519]

**Delay**

Arbus and Caldas 1960 - [520]

**Disston**

Krenzer et al. 1960 - [541]

727

Freyman et al. 1967 - [227]

**Winteringham**, P. P. W., Harris PHOSPHOROTHIOATE POISON

A significant reduction in the DPF is reported. The stimulated lesions in addition to that of the fact that the amount does of fly from the stimulated respiration the typical mummies. The same necrobiotic of inhibited mummies otherwise lethal doses of DPF.

**Bunts et al. 1963 - [464]

**Gavin et al. 1963 - [465]

**Hagley and Morrison 1968 - [466]

Hoffman et al. 1961 - [465]

**Hoffman et al. 1962 - [470]

**Hofmann and Witt 1958 - [471]

**Lettow and Morrison 1966 - [467]

**Lindquist et al. 1961 - [471]

**Lindquist and Dohm 1967 - [466]

**Morrison and Letouw 1964 - [466]

**Perry et al. 1966 - [483]

**Perry and Buckner 1960 - [466]

**Robbins and Dohm 1965 - [487]

**South and Lindquist 1963 - [466]

**Schmidt and Weidhaas 1969 - [467]

Terepke, L. C., School, R. J. TREATED WITH CARBONIC LA

The study was aimed at investigating the previous authors concerning the use of acceptable techniques in the treatment with radioactive tritium up to 80% of the dose in the for and excretion capacity. The use of all of the absorbed dose in the compound weedy acid in not several possible treatments have.
\[ \text{3-DEETHYL 2-NAPHTHALIMIDO} \]

**3**

DNP was converted to the oxygen-photolabile acid and at least three free radicals are formed. The degradation of number of metabolites in the proximal area was not effective as an animal and most of the absorbed material remained limited extent. Some degraded free radicals were not effective as an animal and most of the absorbed material remained limited extent.

**727**


A considerable reduction in the rate of \( \text{C}^{14} \) acetylation of choline by the insect in vivo as the result of DNP is reported. The stimulated respiration and glutamine accumulation indicate possibly actual biochemical lesions in addition to that of cholinesterase inhibition in the DNP-poisoned insect. This view is supported by the fact that various doses of pyridine-2-aldehyde methiodide (PADM) failed to protect the DNP-treated fly from the stimulated respiration and some delayed lethal effect, although it protected the insect from the typical paralysis. The same doses of PAM alone did not have toxic effects on the insect. It is a potent reactivator of inhibited mammalian cholinesterases in vivo and in vitro, and will protect mammals from otherwise lethal doses of DNP.

**602**

**728**

Burr, J. et al. 1965 - [464]

Ghaffar, M. et al. 1962 - [465]

Hagley and Morrison 1968 - [467]

Hufford et al. 1953 - [469]

* 1952 - [470]

Hodkin and Wirt 1958 - [471]

Leibovitz and Morrison 1958 - [474],[475]

Lindequist and Dalen 1956 - [477]

Morrison and Leibovitz 1954 - [482]

Perry and Bockner 1958 - [486]

Robbins and Dalen 1958 - [487]

Roth and Lindequist 1953 - [488]

Schmidt and Weidhas 1960 - [501]

**729**


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 metabolization 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 deconjugation and excretion capacity. The excretion begins during the first day after treatment and appears to continue until all of the absorbed dose has been metabolized. The conjugate is hydrolysable 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.

* Weidhas and Schenato 1960 - [501]

A comparison was made of the effects of methyl bromide, ethylene dibromide, and ethylene dichloride on 32P-labelled intermediates extracted from the thoracic muscles of houseflies. The slow depletion of phosphoglycogen by the first two chemicals suggested a common inhibition of triose phosphate dehydrogenase, they thus resembled hexosamine in their action. Depletion of ATP and adenosine phosphoric acid by methyl bromide indicated a rapid blocking of the phosphorylation of nucleotide acceptors.


A quantitative study is described (see preliminary communication by Winteringham and Helley, 1964). Techniques described earlier (Winteringham, Bridges and Helley, 1965) were used with only minor modifications for 32P-labeling of the soluble intermediates of the adult insect in vivo, and for their extraction. The paper-chromatographic techniques used were also very similar to the previous one. 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. Tabled 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 effect of ethylene dichloride vapor and injected isocitric 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.

Dawson and Plapp 1960 - [568]

March et al. 1966 - [567]

Mengle et al. 1969 - [568]

Kreitzer and O'Brien 1968 - [565]

Kreitzer and O'Brien 1969 - [565]

Arthur and Castile 1963 - [8]

David 1965 - [569]

David 1967 - [569]

McNellis and March 1963 - [8]

Pietri-Tonelli and March 1964

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 P32-labeled material attempting to correlate resistance with ease of hydrolysis.

Parathion

* Gar et al. 1964 - [973]
* Lockau et al. 1951 - [381]
* Lockau and Känicke 1952 - [532]
* Tomisawa et al. 1960 - [588]

Phenate

* Bowman and Cardia 1959 - [560],[561]

Pyrethrin

* Blum and Koah 1956 - [669]
* Bridges 1957 - [970]
* Earle 1962 - [971]
* Hopkins and Robbins 1957 - [872]
* Pellegreti et al. 1952 - [873]
* Schmidt and Delah 1966 - [878]
* Winteringham 1952 - [879]
* Winteringham et al. 1953 - [879]
* Zeid et al. 1943 - [880]

Ponnet

* Hopkins 1960 - [992]
* Loujades 1953 - [600]

Schaden

* Arthur and Cardia 1958 - [804]
* David 1950 - [569]
* David 1951 - [780]
* Metcalf and March 1953 - [826]
* Pietri-Tonelli and March 1954 - [628]
Sevin


Aphids which had been rendered moribund were supplied twice a week as food to the predators in petri dishes. The predators tested were the Syrpheidae, Baccha clavata (F.), Mesaphis wiedemannii (Johnson) and Allograpta obliqua (Say), the Cocconellidae, Seymourianemoricula gen. et spec., Euphorus Muls., and Dysaphis conjugata (Germ). Conocephalus (Chileapopile) murinus (Deg.) and Coccophagus angulicollis (L.). and the Chrysopterae, Chrysopa fulvipes from. and C. ocellata Say. Larvae of all these species and adults of the Cybercoelidae were used and mortality counts were made daily. The different effects shown by the results are discussed. In some of the tests, Systox prepared from radioactive sulphur (95) was used, and the predators were dead, ground and assayed for radioactivity. The radioactive material apparently accumulated in the bodies of the larvae, since third- and fifth-instar (imaginals that survived treatment showed 4.26 and 7.29 cpm/mg, as compared with 22.6 and 18.32 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 cast pupal skin showed much more than either. Larvae of Chrysopa ocellata that fed for 8 d showed 1.94 cpm/kg, but survived.

David 1957 - [635]

Elferink and Gooden 1939 - [635]

Fukato et al. 1965 - [635]

March et al. 1955 - [640]

Zea


In order to study the fate of organic phosphates in Zea mays L., radioactive DPP and PPA were dissolved in acetone and administered to adults of both sexes by topical application to the cervical membrane or 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 autoradiographs were used to study the gross distribution of DPP 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 microscopy, is described. The distribution and relative concentrations of DPP, PPA and PPA-3 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.

Roza et al. 1950 - [633]

Miscellaneous


The strains of houseflies compared were the susceptible S-F, derived from NAIIDM 3466 stock, and the resistant R-08, selected for DDT resistance for 145 generations. Fly eggs were added to what amounted to a solution of about 0.185 mg at 100 ml. The culture was maintained in a room held at 26 °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 phosphate 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, 5.3 d for the residue, but more supplementing radiometric...
5.8 d for the residue, but more than 11 d for the lipid fraction. This work emphasizes the necessity for supplementing radioisotope techniques with routine chemical procedures in the study of biological processes.

* Benjamini et al., 1956 - [555],[557]
* Belitst et al., 1955 - [562]
* Benitz and Bucovec, 1958 - [500]
* Casta, 1955 - [597]


The toxicity of benzoic acid to these larvae was reduced in the presence of glycine. The efficacy 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 equilibrium determination mechanism. Benzoic acid was 10 times as toxic as hippuric acid to these larvae. Using (L-2,4) glycine it was shown that monoglutamate can synthesize hippuric acid and probably in the conjugated product. Thirty amino acids and closely related compounds were tested for their efficacy 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 detoxification mechanism. (auth. summary)

* David, 1952 - [711]
* Federickson and Uill, 1955 - [57]
* Komsantsky, 1955 - [564]

755 Mengle, D.C., Casta, J.E. BIOCHEMICAL FACTORS IN THE ACQUIRED RESISTANCE OF HOUSEFLIES TO ORGANOPHOSPHATE INSECTICIDES. J. Econ. Ent. 58, 2 (1965) 433-7.

The metabolic fate of P-labelled Dimethoate, Malathion, and methyl Parathion was studied in three housefly strains, two of which were resistant to organophosphates. Rate differences between the strains in cuticle penetration, phosphonothionate oxidation, or phosphate hydrolysis did not appear to explain the resistance. The latter in vivo cholinesterase inhibition in resistant susceptible flies treated with the same dose of the organophosphate probably results from some other mechanism than desensitization. Flies treated with the organophosphate immediately after decapsulation were similar to whole flies in the symptomology of poisoning and some evidence of poisoning in the thorax and/or abdomen which contributes to resistance by reducing the rate of cholinesterase inhibition without destroying active anticholinesterase organophosphate.

* Papp and Casta, 1958 - [565]


Aerosol-water suspensions of solutions of radioactive DDT, BAYE 21,199, and Am. Cyanamid 12880 (C,C-dimethyl 2(5-methyl-2-carboxamidoethyl)-phosphonothionate), labelled with C and P respectively, were tested against 4th-instar Aedes quadrimaculatus Say and Aedes taeniorhynchus (Wied.) larvae (Culexidae: Diptera). Concentrations required for equivalent 24-h mortality were in the order of DDT < BAYE 12880. A. quadrimaculatus were more susceptible to DDT and 12880 but less to 21,199 than Aedes taeniorhynchus but at the LD<sub>50</sub> only small differences (0.020-0.046 mg/larvae) 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, 72% 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.)
II - H - 2 MAMMALS

Survey

- Liddicoet 1964 - [505]
- Winteringham and Barnes 1885 - [438]
- Winteringham 1967 - [724]

Boyd and Arthur 1960 - [728]

Kaplan et al. 1968 - [213]
- Krueger et al. 1959 - [514]
- Lindquist et al. 1958 - [515]
- Radeloff and Clahorn 1960 - [516]
- Robbins et al. 1959 - [317], [318]
- Vickery and Arthur 1950 - [519]

DDT


A study of DDT-derived products occurring in plasma and bile, following the ingestion of DDT, show that the major products are complexed with DDA (bis-2-chloroethyl) acetic acid) in both bile and feces. Uncomplex DDA is found in the bile, and insignificant amounts of DDA (L,2-dichloro-2,3-bis-(2-chlorophenyl)-ethylene) are present in both bile and feces. DDT-CMC was used to demonstrate that the Scholz-Haller method fails to account quantitatively for these metabolites. Dietary excercise is responsible for almost all of the DDT metabolites in feces. Although bile and fecal metabolites have certain similarities, they are not necessarily identical. (from pub.)

- Mothe et al. 1957 - [388]

Debary

Arbus and Casta 1960 - [830]


Cebrian, G., Gartland, P. E., Hopkins, D. E. METABOLISM OF P-DEBARY IN CATTLE.

P4 labeled Debary (C3H4O5H) was applied to stems dermally and orally. Analysis of blood, urine, and feces indicated that the insecticide was rapidly metabolized and excreted. After 7 days both animals showed traces of radioactivity in the urine and feces, but the elimination of 90.4% of the label occurred within 24 h. The main metabolite was P-4-debary. Isoprenoid material in the urine of both animals indicated a cleavage of Debary at the P-4-C bond, with oxidation before or after hydrolysis. (auth.)

- Plapp et al. 1960 - [521]
DFP

Jander, B.J., McManus, P.D. DISTRIBUTION OF RADIOPHOSPHATE IN RABBIT TISSUES AFTER INJECTION OF PHOSPHATE-LABELED DIETHYLPHOSPHATE. J. Pharmacol. 98 (1960) 77-84.

When 32P-labelled diethylphosphosphate (DFP), a highly toxic phosphoric acid ester, is injected intravenously in rabbits, 32P 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 (1) of rabbit organs and their ability to retain DFP-derived P. No significant retention of 32P in any tissue was found when labelled diethylphosphate was administered. Of the total amount of DFP-derived 32P 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 32P originally present is eliminated before regeneration of 1 has started. In the erythrocytes a maximum value of 32P 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 1 is maintained for the same length of time, then both the radioactivity and 1 inhibition decrease at the same rate and return to zero at approximately the same time. This indicates destruction of erythrocytes whose 3 was destroyed by DFP, and their replacement with new cells containing active cholinesterase. (CA 64; 4378a, 1960)

Discussion

Kneer et al. 1960 - (541)
Robbins et al. 1967 - (543)


Les auteurs ont préparé un diazina marquée avec du phosphore radioactif. Après avoir administré par os 235 mg d'une chevre en fin de lactation, ils ont mesuré la radioactivité des urines, des fèces, du lait et du rein. Cette étude montre une élimination rapide et complète du produit en 3 ou 4 jours. Seule l'élimination radiactive, d'ailleurs extrêmement faible du lait reste lente et correspond à une radioactivité des urines conservée après métabolisme de l'insecticide. Le dosage de l'insecticide lui-même, soit par extraction, soit par la mesure de la radioactivité ésicholinesésique des excréments montre une élimination très lente (2 à 3 fois de la dose totale en 4 jours), tractant que la quan-tité de l'insecticide est métabolisé et le 3P éliminé sous forme de phosphates organiques ou minéraux autres que l'insecticide. Ce comportement diffère nettement de l'insecticide organophosphére de l'insecticide chloro.


A female goat (36.5 kg) was given a single oral dose of 32P-labelled Diazina (O,diethyl-G-4'-isopropy2-4-methyl-6-cyclodimethylphosphonooxymethane) towards the end of the lactation period. Extraction 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 Diazina, unlike the chlorinatedhydrocarbon insecticides, is rapidly metabolized in the animal body. (From RÜK-A 47:2414, 1969)

Discussion

Chettle and Beecham. 1960 - (768)
Dauterman et al. 1960 - (552)
Dauterman et al. 1960 - (551)
Kaplan et al. 1959 - (550)
Diphenoxylate


A study was made of the metabolism and excretion of pL-labelled bayer 133/59 (dimethyl 2, 3, 3-trifluoro-1-hydroxyethylphosphonate) by a lactating Hereford cow to which it was administered orally at the rate of 5 g/kg and at its uptake by larvae of Hypoderma bovis (Dey.) in cysts in the cow's back. Radioactivity appeared to be dispersed more slowly in the exudate in the cysts of H. bovis than in the blood. Only low levels of radioactivity were detected in laves removed at various times after treatment, and the maximum per unit weight was found in those removed after 6-24 h. The percentage of radioactivity administered appearing up to 144 h after treatment in the milk is discussed. L133/59 is rapidly metabolized by the cow and eliminated in the urine. The rate of elimination is described. Radioactivity of L133/59 by the cow was impaired by the small amount of radioactivity in the feces. Less than 3% of the dose was accounted for in all fecal samples collected. (RAE 46: 31-33, 1939)

DNP

Sande and Marcott Since 1952 - [769]

Fumarigene


The study of radioactivity in different tissues was examined, following absorption of CMCl4.

In order to study the metabolism of CCl4, monkeys were exposed to low vapor concentration of the radioactive form. Human monkeys inhaled air containing 46 ppm of CMCl4 for 100-200 minutes. About 50% of the inhaled CCl4 was absorbed. The highest concentration of deposited radioactive material was in the fat. (7.24 times the concentration in the blood). CM was found in the blood carbonate, exhaled CO2 and urinary area and carbonate. Most of the radioactivity in the urine was present in nonvolatile fraction other than urea, carbonate, or amino acids. This material was retained on anion-exchange resin and was converted to another unidentified substance by acid hydrolysis. The equivalent of about 81% 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 45: 8186, 1951)

Strittmatter et al. 1950 - [422]

Malathion

Knack and O'Brien 1960 - [764]

March et al. 1956 - [667]


Two Jersey heifer calves were each treated twice at an interval of two weeks with one 2-plc sprayer containing 0.06 pL-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; 92-99% 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 greatest 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 cuts of the meat and in tongue, brain, spinal cord, testis, thyroid, pancreas, kidney, liver, heart, neman, ear, bone, marrow and tibia were determined radiometrically. 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 uncharged Malathion and chloroform-soluble metabolites. Total residues in the meat cuts were low (0.05 - 0.15 ppm) and indicated very uniform disturb for the tongue were probably not (0.2 - 2 ppm) were found in thym from the degraded compounds, etc. The largest amount (5 - 16 ppm) of foreleg, hind leg and snout al (RAE 46: 197, 1937)

* Source and O'Brien 1960 - [586]

* Bennett et al. 1954 - [663]

* Garcia et al. 1951 - [668]

* Larson and Hartley 1956 - [666]

* Ahmed et al. 1968 - [571]

* Jager 1953 - [576]

* Jenney 1952 - [577]

* Ledonco 1954 - [564]

* Bowman and Castile 1958 - [500]

* Castile, J. E., Garretson, P. E., OF ORGANOPHOSPHATE INSECT: METHYLOXY-1-PROPEN-2-YL PHER.

Dairy cows that ingested ribosome daily in caprinate for a period of 1 was not detected in their milk or residues in milk or tissues and the phosphonic acid. Calves that were activity. The compound was hydro (from auth. summary)

* Garretson et al. 1967 - [590]

* Location 1958 - [660]

* Pinc and Castile 1958 - [601]

* Robbins et al. 1956 - [605]

* Arthur and Castile 1958 - [604]

* Gardner and Kirkby 1950 - [610]

* Gardner and Kirkby 1952 - [612]
and indicated very uniform distribution throughout the animal. Somewhat higher values (0.15–0.18 ppm) for the tongue were probably attributable to the feeding habit of feeding themselves. Higher residues (0.2–2.0 ppm) were found in thymus, thyroid, pancreas, liver and bone, and indicated that phosphorus from the degraded compound was being used in the normal metabolic activities of the animal.

The largest amounts (0.15–0.18 ppm) were found in the bile. Chemical analysis for Malathion in tissues of foreign, blind leg and mamy of the two batten showed no detectable Malathion (less than 0.2 ppm).

(Reed & Hay, 1957)

* Bennett et al., 1960 – (869)

* Geier, 1963 – (876)

* Bennett et al., 1961 – (866)

* Lasson and Harlow, 1968 – (867)

* Ahmed et al., 1968 – (871)

* Jäger, 1963 – (876)

* Jäger, 1952 – (877)

* Lüdicke, 1964 – (884)

* Bowman and Carsta, 1966 – (891)

* Gatterdam et al., 1967 – (896)

* Labeled Malathion

The effects of p-methylphenyl malathion were studied by measuring the amount of radioactive label in various tissues of the animal. The results showed that the label was evenly distributed throughout the body, with the highest concentration found in the liver, followed by the kidneys, spleen, and heart. The label was also found in the blood and urine at lower concentrations. The label was not detected in the brain or lungs. The results indicated that the label was rapidly absorbed and metabolized by the animal.

* Gatterdam et al., 1967 – (896)

* Labeled Malathion

The effects of p-methylphenyl malathion were studied by measuring the amount of radioactive label in various tissues of the animal. The results showed that the label was evenly distributed throughout the body, with the highest concentration found in the liver, followed by the kidneys, spleen, and heart. The label was also found in the blood and urine at lower concentrations. The label was not detected in the brain or lungs. The results indicated that the label was rapidly absorbed and metabolized by the animal.

(From: H.H. Hamentz, 1965)

* Gatterdam et al., 1967 – (896)

* Labeled Malathion

The distribution, destruction and excretion of the above named compound (9), an anticholinesterase, was investigated in cats and rabbits. It is less toxic than DFP. High concentrations of unchanged 9 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. Metabolite products were excreted in bile, urine and feces. The intraperitoneal route was the most effective mode of administration. (EM 2: 447, 1952)

** Kelby 1953 - [922]

** Fukui et al. 1955 - [335]

** Marché et al. 1955 - [640]

** Tierz 1955 - [832]

** Halberstadt 1958 - [692]

** 1955/1956 - [563]

** Plapp and Cassida 1958 - [695]

** H-1-3 PLANTS

** Leblanc 1964 - [505]

** Metcalf 1964 - [643]


Review article. The metabolites of insecticides produced by plants are shown to be mostly derived from the organophosphorous insecticides with the exception of Aldrin which may be oxidized to Dieldrin. The residue of the relatively stable chlordane 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 radiotopes.

** Baird 1958 - [512]

** Boyd and Arthur 1960 - [720]

** Brandriff and Whitaker 1958 - [446]

** Fang and Thomas 1956 - [705]

** Raisin et al. 1954 - [705]

** Licharzewski and Schultz 1960 - [478]

** Winteringham 1961 - [781]

** Castled, J. E., Ahmed, M. K. MD PLANT FOLIAGE. J. econ. Bot. 2, 2-3-hexanediol 3, 3'-bideC, (loss of the herbs AC-520 compound). Formation of more polar derivatives were similar in persistence to that of insecticide initially applied to the leaves and the glucose derivative. Harcules AC-520 was only slowly taken up by plants. Several of the components were detected when applied to plants. The phosphotriester derivatives were identified as Harcules AC-520 and certain non-aromatic derivatives to plants are not significant of the organophosphorous isomers. The chemical method of analysis Harcules AC-520 was labelled with 14C by Arthur 1959. (auth.)

** Carew and Guernier 1958 - [558]

** Metcalf et al. 1959 - [592]

** Reynolds et al. 1967 - [500]

** Tierz et al. 1967 - [562]

** Tierz et al. 1966 - [561]

** Tomihasa and Sato 1960 - [570]

** Tocisko 1960 - [701]

** Gao and Kipling 1960 - [704]

** Kipling and Gegenawa 1955 - [5]

** Leblanc 1952 - [583]

** Leblanc 1954 - [584]

** Bowman and Cassida 1957 - [589]

** Bowman and Cassida 1958 - [590]
compound (9), an anticholinesterase, was
metabolized unchanged but the method of analysis was not described.

Winteringham 1951 - [781]

Pelray

The anticholinesterase, Hercules AC-982 (Pelray) is a mixture of the cis and trans forms of

\( \text{S}_{3}\text{P}_{2}\text{O}_{8}\text{O}_{3}\text{S}_2 \text{H}_2\text{C}((\text{O})_2\text{O})_2\text{H} \) and certain other phosphonothioates. Loss of the Hercules AC-982 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 plant. No inter-conversion occurred on plants between the cis and trans isomers and the diol derivative, which is an impurity in the technical insecticide. The components of Hercules AC-982 were only slowly hydrolyzed on the plant surface but rapidly when absorbed into the plant. 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-982 to yield the phosphorothioate derivatives were only partially successful. Several components of technical Hercules AC-982 and certain non-hydrolyzed derivatives formed from the Hercules AC-982 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-982 on crops but not determined by the contemporary method of analysis cannot be fully evaluated with the limited data presented in the paper. Hercules AC-982 was labelled with \( ^{32}\text{P} \) by preparation and purification techniques described earlier (Castles et al. 1962). (auth.)

Dif-Syston

* Carter and Gottner 1968 - [538]
* Metcalf et al. 1969 - [529]
* Reynolds et al. 1967 - [560]

Gusathion

* Tietz et al. 1957 - [502]
* Tietz et al. 1960 - [501]

Malathion

* Torii and Saw 1960 - [570]

Nicotine

* Toso et al. 1960 - [791]

Parathion

* Gas and Kipling 1956 - [574]
* Kipling and Gogenawa 1965 - [579]
* Liddle et al. 1960 - [582]
* Liddle et al. 1964 - [584]

Phorate

* Bowman and Castles 1957 - [383]
* Bowman and Castles 1958 - [380], [501]

179
plants growing in sand and into former plants than on the latter. Vapour by the leaves. This vapour was sampled on the cut ends of broad beans contain radioactive material. To test relative rates of translocation of the leaves of broad beans were translocated following procedures.

**Harley and Heath 1951:** [816]

**Heath et al. 1982:** [818]

**Heath and Lavelleyn 1983:** [817]

**Heath et al. 1988:** [820]

**Metcalf and Marsal 1989:** [821]

**Metcalf et al. 1985:** [822]

**Stein et al. 1989:** [823]

---


The radioactive anhydride was absorbed by the roots of broad bean plants placed in culture solution containing it. The level of radioactivity in the plant increased as the solution was absorbed and was higher in the washed roots than in the rest of the plant. The activity of the remaining culture solution increased as more was absorbed, showing that the roots selectively reject the radioactive anhydride. The material was more slowly from soil than from sand. In both cases, the concentration per gram of tissues 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 50% of the anhydride was decomposed within the plant in 8 h. The concentration of undecomposed anhydride in the plant was determined by 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 those 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 the use of high concentrations, it was shown that the roots selectively reject 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.

---


The absorption of the systemic insecticide bis(dimethylamino) phosphorophous oxide containing 32-P was studied and, where possible, comparisons were made with Schrader (bis(dimethylamino)phosphorus anhydride). 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 roots than in the rest of the plant. The activity of the remaining culture solution decreased as much of it was taken up by the plants, showing that the roots selectively absorb the oxide from solution. In this respect, it differs from Schrader, which is selectively rejected at similar rates of translocation. At the end of a day with roots in the culture solution, the plant became free from aphids. The radio-oxide was absorbed more rapidly by
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 radioactivity absorbed by the root 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-activity was less soluble in lipids than schradan and did not penetrate as readily into leaves of broad beans. Since it is also lost by evaporation from the plants, only small amounts were translocated following leaf applications to broad bean, cabbage and hops.

- Harley and Heath 1951 - [618]
- Heath et al. 1952 - [612]
- Heath et al. 1953 - [617]
- Heath and Llewellyn 1953 - [619]
- Heath et al. 1955 - [620]
- Metcalfe and March 1953 - [621]
- Metcalfe et al. 1955 - [622]
- Stein et al. 1952 - [627]


The translocation of 32P-labelled Schradan from dipped or sprayed leaves was studied in apple, chrysanthemum, broad and runner beans and Colias. Light was found to be perhaps the most important single factor in promoting translocation to beam, apple, and chrysanthemum, suggesting that the insecticide moved along with the products of photosynthesis. The direction of translocation from lower or middle leaves was predominantly upward toward new growth although small amounts were found in the lower leaves of apple and chrysanthemum following application to middle leaves. Upward translocation occurred largely in the phloem in apple stools. Although limited upward translocation also occurred in the xylem, downward translocation occurred exclusively in the phloem. No major difference has been observed in the ratio translocated/absorbed for *Colias*, bean 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 *Colias* in chrysanthemums and apples the breakdown appears similar throughout the plant whilst in beans and, possibly, *Colias* the breakdown in the unexposed sections is higher. Concentrations necessary for the kill of certain species of aphids are given (60% mortality for *Aphis fabae* Scop. with 10-15 mg/kg of fresh weight of plant tissue, 20-35 mg/kg for *Macrosiphum (Macrosiphoniella) rosae* and *Hillii* and 20-30 mg/kg for *Aphis pomi* Dug.).

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

- Wedding and Metcalfe 1962 - [629]

**System**

- Ahmed et al. 1964 - [630]
- Chatterjee 1969 - [631]


The author studied the process of absorption of systemic insecticides by seeds. 32P-Sysox third instar 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. 75% of the material was in and on the seed coat, but after 24 h only 52% remained. Removal of the seed coat from seeds stored 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 (h.) Translocation occurred directly from the material absorbed in the cotyledons which passed along with the food reserves. However, none of the insecticide was found to have diffused out of the treated seed into the soil when it was subsequently absorbed by the roots. It is clear that these two methods of absorption also apply to seed coasts where the relative rates of absorption depend upon the liquid and water soluble of the insecticides; the porotive power of the coating substance, generally charcoals; and the adherence of the coating to the treated seed.

- David 1857 - [50th]
- Pinozoto et al. 1955 - [50th]
- Pinozoto et al. 1956 - [625]


Experiments are described on the metabolism of O-O-dieethyl O-2-ethylthioethyl phosphorothioate (Demeton-O) in cotton plants. Demeton-O prepared with 106 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-dieethyl O-2-(ethylthioethyl)phosphorothioate (the thionophosphate sulphide), which is therefore shown to be a metabolite of Demeton-O. It is a secondary one, since the first step in the metabolism of Demeton-O in plants has been found to be conversion to the sulphonide, O-O-dieethyl O-2-(ethylthiophenyl)phosphorothioate. (from RAE July 1968)

- Hartley 1932 - [536]
- Metcalfe et al. 1956 - [641]
- Metcalfe et al. 1966 - [640]
- Metcalfe et al. 1977 - [644]


When the bases of young cotton and lemon plants were treated with dithio-Synthox (O-O-dieethyl S-2-(ethylthio)ethyl phosphorothioate) and Thimet (O-O-dieethyl S-ethylthiomethyl phosphorothioate), synthesized from 2-thiophenylphosphonic acid, the compounds were absorbed and translocated at about equal rates, but only about 0.5 to 0.7% of the total sulfur was found to be much more soluble in water. The processes of metabolism for the two compounds were primarily oxidative. After uptake of dithio-Synthox by cotton, tomato, bean or leucine plants, the compound was oxidized very rapidly to produce the sulphonide, O-O-dieethyl S-2-(ethylthiophenyl)phosphorothioate, and more slowly to produce the corresponding sulphoxide, O-O-dieethyl S-2-(ethylthioethyl)phosphorothioate. The sulphonide and sulphone, were also oxidized to produce O-O-dieethyl S-2-(ethylthioethyl)phosphorothioate and O-O-dieethyl S-2-(ethylthiol)phosphorothioate, respectively. Thus, at intervals of a few days in a month after application, all 4 oxidation products may be present in plant residues, but no dithio-Synthox remains. Thimet behaves in an analogous manner, but showed different rates of metabolism.

The sequence of consecutive reactions for dithio-Synthox and Thimet in isolated cotton leaves was plotted, and preliminary investigations on their kinetics were made. All the simple oxidative metabolites of dithio-Synthox and Thimet were prepared in 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 study being somewhat more active of the two. Typical harvest residues of the dithio-Synthox metabolites were evaluated in experiments in which the radioactive compound was used as a direct spray on cotton plants 55 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 abstract, summary)

- Milbrath and Tiets 1956 - [579]
- Stein and Smith 1954 - [640]
- Thomas and Glynn Jones 1955
- Thomas et al. 1956 - [658]
- Tiets 1964 - [651]


F subtly review, investigations on have been used. When symptoms is down in the phloem at first, but was determined to range from 0

- Bowman and Casida 1959 - [68]
- Halldemsted 1964/1965

757 Votzke, G.K., EFFECT OF PL PHOSPHATES BY KURUS RAJIA 611-S.

Results of greenhouse trials indicated the development of these Determinations of O uptake and the tissues was accompanied by relatively short time after the i case of benzene hexachloride, benzene in the soil as well as CA 49; 5764d, 1969)

II -

- McCoombs 1958 - [799]

758 Kloiber, H.V., Balaban, H.C RESIDUES FROM LIVESTOCK S.

Before an insecticide can be used it will contaminate meat and K carbon insecticides, Co, are also made on EMD, IID, and GYRINE, TOXAFON, MALATHI p-coined Co, are and Delta (A more detailed report was publised Ag. Res. Serv. US Dep. Insecticides on pasture and for)

- Kaplanis et al., 1958 - [513]
after 24 h only 35% remained. Removal of the seed coat at time of planting reduced the number of viable seeds to a number too small to be counted. Translocation of the treated seed into the seedling occurred at the time of emergence, with the bulk of the radioactive material being translocated within 24 h. The pattern of movement in the plant is complex and involves both root and shoot translocation, with the root system playing a significant role. The radioactivity was not limited to the shoot system, with some activity also detected in the root system. The radioactive material was found to be evenly distributed throughout the plant, with no significant accumulation in any particular organ or tissue. The results suggest that the phytotoxicity of the herbicide may be due to the uptake and subsequent distribution of the chemical within the plant. Further studies are needed to understand the exact mechanisms of uptake and distribution, as well as the impact on plant growth and development.
and fed to animals. 

**Knepper et al., 1960 - [544]**

**Radcliffe and Glasson, 1960 - [546]**

**Robbins et al., 1969 - [519]**

* Delav

**Olejnik**, 1960 - [521]

* Diaminos

**Robbins et al., 1957 - [548]**

* Dinitrothoate

**Deantzen et al., 1959 - [562]**

**Kaplan et al., 1959 - [553]**

* Phosdrin

**Casida et al., 1956 - [746]**

**Guthmund et al., 1957 - [590]**

* Round

**Robbins et al., 1956 - [602]**

**USDA 1957 - [563]**

**II - 2 - PLANTS**

**Surveys**

**Menon et al., 1954 - [527]**

**Reidman and Melake, 1958 - [781]**


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, 1952 - [447]

**DDT**


A radioactive bromine analogue, 1,1-di-chloro-2,2-di(6-bromo-phenyl)ethene, of the insecticide DDT has been used to indicate the fate of DDT sprayed on to wheat grains which is subsequently milled, baked

---


Use of a radioactive bromine analogue to determine the fate of DDT on wheat grain, followed by DDT having been oxidized, to determine the fate of the methyl group and to determine the inorganic residues, using DDT.

**762** Dupont, L. F., Heath, D. F., C. Diamicid fluoride (DIMEPOX). A satisfactory method for the determination of the DDT-0.1 ppm or less. The method for the determination of residues, extracting with chlorinated distillation apparatus, and distillation is eliminated as can sometimes be used. The separating the dimethox from the obtained on 15 crops, and with obtained by adjusting known water (from auth.)

**763** Cedewall, B. D., Beuchamp, P. D., Pas organoaluminum (POA)

A method for determining pesticides organic compounds, (Dimepox) chemical and biochemical interference from metabolites is 5 µg of Dimepox, and residues found in many British auth.


The chemical fate of DDT, whole wheat flour was prepared from the and was responsible for some 80% of the volatile residues obtained on it.
condition, it was shown that the decomposition of methyl bromide in grain was due almost entirely to
metabolism with the formation of 80% of N-methyl derivatives, 20% of dimethyl sulphonium derivatives,
and of 20% of methoxy and dimethoxy derivatives (in about equal proportions). Similar results were
obtained when grain alone was exposed to the labelled fumigant. The production of formaldehyde in the
fumigated grain 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 86-06-labelled
sulphate. (auth.)

Bridges, R.G., THE FATE OF LABELLED INSECTICIDE RESIDUES IN FOOD PRODUCTS. III. N-METHYLATION
The principal reaction between 86C-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. These methylated histidines are present in the hydrosoluble acid hydrolysate of the protein
that has been exposed to methyl bromide, and these have been identified as 1-2-0-methylhistidine, 3-2-0-
methylhistidine and 1-2,0-dimethylhistidine. The amount of reaction occurring under normal fumigation
conditions is so small that the loss of the semimethylamino acid, histidine, is negligible. (auth.)

Bridges, R.G., THE FATE OF LABELLED INSECTICIDE RESIDUES IN FOOD PRODUCTS. IV. THE NATURE
AND SIGNIFICANCE OF ETHYLENE DIBROMIDE RESIDUES IN FUMIGATED WHEAT. J. Sci. Food Agric.
2, 6 (1959) 255-7.
Ethylene dibromide labelled with radioactive bromine (Br39) was used to study the absorption in wheat during
fumigation and on subsequent airing and heating. In spite of the high physical absorption of the fumigant and
its slow rate of dispersal by airing, there is little chemical reaction between it and the wheat at room
temperature. When fumigated wheat that has been imperfectly aired is heated, part of the ethylene dibromide
sorbed on it undergoes decomposition to ethylene glycol and monobromoacetic acid, the remainder being lost
by volatilisation; as ethylene glycol is a 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 starch-granule sheath. It is concluded that no significant changes
appear likely to take place in the nutritive value of wheat as a result of fumigation.

Winteringham, P.F.W., THE FATE OF LABELLED INSECTICIDE RESIDUES IN FOOD PRODUCTS. V. THE
POSSIBLE TOXICOLOGICAL AND NUTRITIONAL SIGNIFICANCE OF FUMIGATING WHEAT WITH METHYL
The major products of the chemical reactions between methyl bromide and the components of wheat under
the conditions of fumigation have been characterised 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
methylmethanol, methylhexanol, 2-methylimidazole, methylmethoxime sulphoxime 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 obtain 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. 86C-labelled methyl bromide was used (see
Winteringham, Harrison, Bridges and Bridges, 1959) (from auth.)

Osmann

Tien et al. 1987 - [662]
W Tien et al. 1980 - [661]

Malathion

Matsumura, F., MALATHION RESIDUES ON AND IN THE LEAVES OF PHASEOLUS VULGARIS. J. econ.
Ent. 52 (1959) 452-4.

Jackson and Hopkins 1982 - [558]

* Gar and Kpliant 1956 - [575]
* Turrill 1950 - [741]
* Turrill and Chaventak 1950 - [572]
* Glynn Jones and Thomas 1963
* Heath et al. 1952 - [618]
* - 1953 - [617]
* Heath and Kleveland 1959 - [611]
* Heath et al. 1956 - [621]
* March et al. 1964 - [622]
* Mersal et al. 1965 - [663]
* David and Gardiner 1955 - [593]
* Hartley 1952 - [608]
* Mersal et al. 1966 - [631]
* Miltmann and Tietz 1956 - [578]
* Stein and Smith 1964 - [649]
* Thomas and Glynn Jones 1964
* Thomas et al. 1955 - [640]
* Tietz 1956 - [599]
* Casida et al. 1956 - [665]
* Halberstadt 1959/1960 - [595]
FOOD PRODUCTS. III. N-METHYLMETHIONINE. J. Sci. Food Agric. 2

Nitrogen-containing groups of wheat. The production of free methanol in the rate of spontaneous decomposition on was estimated by using wheat which

PARASITIC: Gar and Kipling 1956 - [574]

G. Turrell 1950 - [710]

Turrell and Clews 1950 - [711]

Schulman

Glynn Jones and Thomas 1933 - [812], [814]

Heath et al. 1932 - [818]

Heath 1938 - [817]

Heath and Llewellyn 1938 - [819]

Heath et al. 1950 - [821]

March et al. 1954 - [822]

Metcalf et al. 1955 - [825]

SYNTHESIS

David and Gaddiner 1955 - [758]

Harley 1952 - [533]

Metcalf et al. 1955 - [843]

Mühlnmann and Tietz 1956 - [646]

Sects and Smith 1964 - [547]

Thomas and Glynn Jones 1956 - [645]

Thomas et al. 1955 - [546]

Tietz 1956 - [560]

MISCELLANEOUS

Casta et al. 1966 - [660]

Halbert and Hopkins 1959/1960 - [502]

H-1-3 SOIL:

DRT

Jackson and Hopkins 1952 - [472]
Very useful book, with an extensive treatment of isotope dilution methods and the handling of radiochemical procedures for individual analysis. An author and subject index.

Duncombe, W. G. AN AUTOMATIC PHOSPHORUS-32 AND SULPHUR-35 ASSAY.

Gillies, M. Y. A SIMPLE AUTOMATIC SULPHUR-35 AND PHOSPHORUS-32 ASSAY.
Specimens labelled with both radioisotopes and packed in one film, while the high-speed technique is described.

A useful system for counting the number of nuclei in a strip of the section, and for recording the distribution of preparations are used for time-course studies.

Metcalf 1969 - 315

Stern, J. L. AUTORADIOGRAPHY.
Work on micrococcal nuclease of labelled DNA labelled with tritiated thymidine was performed using autoradiography techniques.

One method involves the use of osmium tetroxide, which is applied to the tissue by a solution of tritiated thymidine, a common technique. This method is described in detail.
III TECHNIQUES

Survey

Comar, C. L. RADIONUCLIDES 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 radiogrammetry; properties and procedures for individual radioisotopes: autoradiography; paper chromatography; and radiometric analysis. An author and subject index is included.

III - A Autoradiography


The method used by Gillette (1963) for studying insects labelled with both P-32 and S-35 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 S-35 or P-32 could be distinguished by covering them with two pieces of X-ray film, and preparing autoradiographs. The low-energy S-35 beta-particles (0.47 MeV) were found to blacken only one film, while the high-energy P-32 beta-particles (1.71 MeV) penetrated the first film and blackened the second as well. S-35, in addition to P-32, is being used for fluid studies on Anopheles gambiae. The technique is described.


An optical system for reading 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 photometric recording of the distribution of band intensities along the strip. Examples in which Drosophila salivary gland preparations are used for measurements are given, where the DNA was measured in terms of P-32.

772 McIvor 1960 - [413]


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


One method tried for locating water-soluble H-3 in larvae of Calliphora erythrocephala (cerebroside AgN03) 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 H-3 have been obtained from larvae poisoned by methyl iodide, by a combination of the Aimann-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 $^90$Sr-paekte plaques 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. (NSA 6 2867, 1952)

A means is given for calculating the dose of radiation, in mrad, absorbed by adult Tribolium castaneum (Lufn.) 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 insects which pertain to the calculation of dose are reported. (auth.)

* King 1962 - [888]

777 Knope, W. DIREKTES UND INDIREKTES VERFAHREN ZUR MESSUNG DER BETA-STRAHLENABSORPTION VON KLEINSCH EMPFEHRUNGEN AN INSEKTEN. (Direct and indirect techniques for measuring the absorption of beta-rays) G. l. t. Clasabemmente-Technik 3, 3 (1962) 78-110. (in German)

In order to determine directly the absorption coefficients for beta rays of different tissues, the various tissue layers of the $^{32}$P-labelled insects are removed. Changes in radiation intensity that produce are measured. For a known, microscopically determined tissue thickness the tvue activity (measured the absorbing tissue) may be calculated from the measured impulse rate. This the indirect method, the original impulse rate is re-established by integrating aluminum foil of known surface density, which will give data on the successive cuts. 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 $\gamma$-isomer of benzene hexachloride led to the development of a new isotope dilution method using CI-2 labelled pure $\gamma$-isomer as a tracer. A known quantity of chemically pure radioactive $\gamma$-isomer of benzene hexachloride, labelled with $^{36}$Cl, 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 4.2%.$^{2}$ $\gamma$-isomer content. Few determinations can be made by one analyst in an 8-day period. This analytical procedure can be classified as an absolute method and is being used as a reference 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 (1960) 69-1.
The essentials of the isotope dilution method are outlined. CI-2 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 detail)


Labelling of benzene hexachloride precursors taken to ensure par given, and the accuracy and of the isotope dilution method. Collaboration studies between c technical grade BHC indicate c

* Palen 1964 - [644]

781 Redemann, C. T., Metklin, R. PERSPECTIVES IN NEW YORK, Interscience Public A method of residue determination the sample with a precisely lin the same substance. The vario to the dilution of non-radioactive with a herbicide.

III -

* Winteringham and Hollyer 1958

782 Winteringham, F. P. W., Hardi LABELED POOL TECHNIQUE. For the study of adult housefly Na acetate -2$^{14}$C, equivalent Me$_2$CO (control) or $^1$H Me$_2$CO. By paper chromatography was thionines, 7 distinct $^1$H-label wear were: (1) 0, (2) 0.25, (3) 0.47 79% of the total soluble $C_6$H$_4$V insoluble thoracic proteolytic eno No detectable formation of the $C_6$H$_4$V fraction was ind nearly showed that no for $C_6$H$_4$V was labelled in vivo to the reduced necessary $NH_2$ dot by a fall to normal after 2 days 1543C, 1957)

783 Winteringham, F. P. W. LAB CHEMISTRY OF TOXIC ACTIVATION. By feeding suitably labelled in which may then be separated papers chromatography may be quantitative evaluation of the domestic 1 was started by F$^{14}$C labelled intermediates in the activation technique. This is

* Winteringham 1958 - [616]

* Winteringham et al. 1968

* Winteringham 1958 - [644]

* Winteringham et al. 1960

190
Labeling of benzene hexachloride by means of the C-14-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. Reutilized 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 - D** Labelled Pool Technique

Winteringham and Hallgren 1954 - [249]

For the study of adult houseflies under the influence of an insecticide, 1 µl H2O containing 18 γ Na acetate-5-C14, equivalent to 5 µc C14, was injected intrahemorrhally. Immediately afterwards, 1 µl MeC14 (control) or 1 µl MeC0 containing 10 γ chloroformic phosphonic acid (1) was applied topically. By paper chromatographic separation (Winteringham et al., CA, 49, 8691b) of extracts of heads and thoraces, 7 distinct C14-labelled fractions were resolved. The main values by H2O-formic acid-acetone were: (1) 0, (2) 0.25, (3) 0.47, (4) 0.56, (5) 0.56, (6) 0.70, and (7) 0.91. Fractions 3, 5 and 6, representing 76% of the total soluble C14, were identified as glycerine, glutamic acid, and protein. Hydrolysis of the insoluble nitrogenous protein showed that almost all the protein C14 was present as glutamic acid and protein only. No detectable fraction of the soluble C14 behaved as free choline. The proportion of C14 found in the acetylcholine fraction was independent of the weight of labelled H1 added at any stage of the fractionation, which fact showed that no enzyme exchange occurred between carrier and some other labelled metabolite. H1 was labelled in vivo in the acyl-moist meal only. The glutamine accumulation suggested that it may have rendered necessary an H2 exchange mechanism. There was a relative ratio of H2 after H1, followed by a fall to normal after 2 and 5 h; this suggests that the cholinesterase inhibition was reversible. (CA 31: 1056c, 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 unidimensional strips for a qualitative evaluation of the particular labelled compound. The soluble phosphorus pool of adult Musca domestica L. was studied by feeding carbon-14 and 32p32O4. The nature and relative specific activities of the γ-33C-labelled intermediates extracted from tissues were determined by co-chromatographic and neutron activation techniques. This technique has also been extended to the use of C-14-labelled pools.

Winteringham 1956 - [316]

Winteringham et al. 1956 - [795]

Winteringham 1953 - [156]

Winteringham et al. 1955 - [495]
III - E Paper Chromatography


In order to study the metabolism in insects of a radioactive bromine analogue of DDT, (Br-C₅H₄)₂CH₂CCl₂ (I), a method was developed for the separation and estimation of (I) and the possible metabolites, (Br-C₅H₄)₂CH₂CCl₃ (II) and (Br-C₅H₄)₂CH₂COOH (III) on the micro-mole scale. Mixtures of such compounds labelled with Br² were analysed 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.


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


An example of the application of this technique is cited where mixtures of DB¹³¹⁺⁺ and its metabolite, "DB¹³¹⁺⁺ and "DB¹³¹⁺⁺, were resolved. The uses and possibilities of combined radiochemical and paper chromatography techniques are discussed. The principle of the methods 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 radioactively. A simple device for doing this automatically, and the use of it in quantitative work is described. (From auth.)


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 suitable 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. There are methods of associating the isotope with one or more bands of the resolved components on the chromatogram as described, as follows: labelling mixture of 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 DB¹³¹⁺⁺ and its metabolite, "DB¹³¹⁺⁺ and "DB¹³¹⁺⁺.

Winteringham, et al. 1958 - [789]

III - F Miscellaneous


An apparatus is described for automatically registering the movement of an object in the three dimensions of space and time. It has been designed especially 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 thyristor, a Genier counter, and a container for 20 ps of Cs¹³⁷.


A machine has 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 lapse-time technique. A tagged wireworm was liberated in a tray tray, and a sheet of glass over the Geiger counter, and held in contact was thus traced on the lower side for viewing through the glass.

Jones, J. C., Perry, A. E.  A N (1949) 245-6.

A simple modification of a micrometer another substance is a suitable as (e.g. as required for topical spray calibration. The three methods - 1.09 g. of DB¹³¹⁺⁺ and 1000 Q-gas flow counter.

Offedal, P.  HANDLING RADIOACTIVITY

An apparatus model of perspex is which eliminates the need for re

Offedal, P. MEASURING THE

A simple tracer method is proper expelled into a drop of water on is then diluted 1:169 or 1:1000. After evaporation to dryness, the of the 2 activities, corrected for precision. To minimize inactive carrier isotope.


By irradiation with the Harwell (N₂, H₂, P₂, and counting it w the counting is done through a of the low-energy As activity de

A sieve for measuring the volume of soil-inhabiting insects is described. The method is based on the principle that insects are trapped in a filter paper sheet, which is then placed in a measuring cylinder and the volume of the resulting suspension is determined. The apparatus is simple and easy to use, and can be adapted to different sizes and shapes of insects.

Reference:
IV BIBLIOGRAPHIES AND GENERAL SURVEYS

IV - A Bibliographies


This bibliography covers the period 1955-1966, "to be continued in subsequent issues."


Among the 507 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 2430 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 1955. An author index and a key to journal abbreviations are included. Sections of interest are underlined.


The 2459 references cited in this bibliography, and obtained from 1948-1960 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. (1950); ISOTOPES: A Five-Year Summary of U.S. Distribution and Utilization (1955); ISOTOPES: A Bibliography of United States Research and Applications 1956-1957 (1958). A list of journals from which these references were selected and an author index are provided.


This bibliography contains 1335 sal husbandry, bacteriology, fertilizers. These references were selected for that have appeared in ISOTOPES: Five-Year Summary of U.S. Distribution and Utilization (1955); and ISOTOPES (1958). A list of the journals from which these were selected and an author index are included.


This bibliography contains 154 sal husbandry and studies of fertilizers. These references were selected for that index is included. (auth.)


This bibliography contains 2154 sal husbandry and studies of fertilizers. These references were selected for that index is included. (auth.)


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

804 Aspinall, J. van DE TOEPASSING EN DEMOOGEOGRAPHIE (The application of isotopes in agriculture) Tijdschr. Groningen Review article. The section on the use of radioisotopes in the uptake of nutrients is well discussed.

805 Dalm, P. A. STUDIES OF INSECT FERTILITY through the Use of Isotopes in Plant and Animal Genetic Materials, Cold Spring Harbor Laboratory. Research Notes. A review is presented of the fast-growing literature in the field, including the use of radioisotopes in the study of insect population, and the use of isotopes to study the physiology of insects.

806 Dalm, P. A., USES OF RADIOISOTOPES IN AGRICULTURAL RESEARCH, Vol. I, Metabolism, Metabolism of plant and animal tissues as influenced by radioisotopes. A very important and comprehensive bibliography on the use of radioisotopes in agriculture, with a detailed discussion of the use of radioisotopes in the study of plant and animal metabolism. The bibliography includes references to the use of radioisotopes in the study of plant and animal metabolism, as well as to the use of radioisotopes in the study of plant and animal physiology. The bibliography is well organized and easy to use, making it a valuable resource for researchers in the field.
This bibliography contains 1535 selected references on uses of radioactive and stable isotopes in animal husbandry, bacteriology, fertilizers 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 ISOPTES: A Three-Year Summary of U.S. Distribution (1949); ISOPTES: A Five-Year Summary of U.S. Distribution and Utilization (1950); and ISOPTES: A Bibliography of United States Research and Application 1955-1967 (1968). A list of the journals from which the references were selected and an author index are included. (auth.)


This bibliography contains 161 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 1957 to 1965. An author index is included. (auth.)


This bibliography supplements TID-3518, Suppl. 1. The 123 references cited are those which have appeared in scientific journals published during the period 1957-1962. The section on entomology contains only 7 references. An author and a subject index are supplied.


(It has not been possible to publish this bibliography. It is presumed to contain some references to the use of radioisotopes in the field)

IV - B Surveys


Review article. The section on insects and insecticides lists radioisotope-labelled insecticides expected to date, and studies on their uptake, transport and breakdown in plants, and the various lines of research being followed at present. 60 refs.


A review of the fast-growing literature dealing with studies of insects and insecticides employing tracers. The literature has been divided into five broad categories: radioactively tagged arthropods with radioactive materials, 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 radioisotopes 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 (3H and 22Na) ration 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, pyrethroids and pyrethrin, butoxide, nicotine, fumigants, and miscellaneous insecticidal chemicals), fungicides, herbicides and
plant 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. 325 references.


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. 64 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 prediction. Some unpublished work (Haasett & Jenkins) is quoted in which malaria, house, and rockpool mosquitoes, houseflies, fruitflies, and snowworm flies were made radioactive by mixing $^{32}P$ with the food of the larvae. Cockroaches and flesh flies were injected with $\gamma$-emitting $^{201}Tl$ to study the possibility of locating insects at greater distances than is possible with $\beta$-emitting $^{32}P$. Guillife (unpublished) confirmed a suspected mite parasite of the cockroach by introducing $^{32}P$ into the mite. $^{32}P$-labelled mosquitoes and fruitflies were shown (H. & I.) to be caught and eaten by praying mantids (laboratory). Feeding by mosquitoes on plants was confirmed (H. & I.) by $^{32}P$-labelled 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.
with radiotopes, epidemiology and other effects. Special techniques and
the use of radiotopes as tracers are reviewed.

ZUNGLERZ. (Radiotopes in
ent. Berl. 8 (1957) 89-14. (in German)
ion effects in terms of induced mutations,
packaging materials, with some
use of radiotopes as tracers as
nes.

Y. Nucleotides 8, 3 (1960) 5-14.

PART II
IONIZING RADIATIONS
Relating, W. H., ed., Nell, P., RELATIVE BIOLOGICAL EFFECTS.
Scientific Laboratory, New Mo.
Numerous references are releva
t in establishing appropriate -
be defined as the ratio of the di-
effect to the dose of another re-
cences may have been missed,
1956. The references are here-
given as those of the author or
mately 509 references are give.

Alexander 1958 - [1145]

Amy, L. L. (UW., Virginia, C.
RAYS, GAMMA RAYS AND X-
DESCRIPTIVE STUDIES ON TH
Dim. Abstr. 11 (1955) 2847
An appendix to the dissertation;
(For abstract, and publication

Amy, L. L. A COMPARATIVE
DEVELOPMENT IN HAMBOBRA
Eggs of luteinotrophus luteinas
γ-rays (CaMo), 1000-5000 roentgen
dosages were adjusted so that ti
all three types of radiation. X:
were less effective and γ-rays
embryos exposed at the highes
ter of those found in irintex.
Although there was indication
processes were for the most pa
seen in damaged eggs but not.
In general, the 1:
increasingly proportional to the a
(An abstract of earlier work)

Baumer and Miller: 1952 -

Bateney, A. J. RELATIVE B
INDUCTION OF DOMINANT
I RESEARCH

I-A Radioisensitivity

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 1969. 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 1968 - (1166)


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 (Lind) were subjected, 1-3 hr after they were laid, to B-rays (Gy), G-rays (Co60), or 125-IV gamma rays under equivalent physical conditions. At each of the 7 dose levels used, desens were 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; B-rays were less effective and G-rays were least effective in this respect. Histological observations made on embryos exposed at the highest dose level were described. Enlargement of nuclei (up to 2 times the diameter of those found in unexposed 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. Internally visible structural disarrangements 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. Res. 115 (1953) 273)

* Baumer, M. and Muller 1956 - (1166)

813 Baranow, A. L. RELATIVE MUTAGENIC EFFICIENCY OF 4 MV X-RAYS AS ASSESSED BY THE INDUCTION OF DOMINANT LETHALS IN DROSOPHILA. p. 144-6 (disc. 169-55). In *Progress in Radio-
These are indications that the Linear Accelerator (404 MeV) is less efficient than the conventional Bevatron. (360 MeV), at least as regards its mutagenic effects on Drosophila.


Production of mutations and lethal dominants are always proportional to the dose administered. The relative efficiency is 6.82. (08 18: 105355, 1956)


The authors report on 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 by means of the Muller-5 (Base) method. Under the described conditions of equal dose (4000 and 3600 r with 1 MeV and 200 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, H. von, Höhne, G. MUTATIONSÄUSLÖSUNG BEI DER TAUFLEGE DROSOPHILA MELANOGASTER DURCH SCHNELL ELEKTRONEN EINES 5 MEV- BETATOREN (Production of mutations in Drosophila melanogaster by fast electrons from a 5-MeV betatron). Strahlentherapie 92 (1953) 32-4. (In German)

In studying the mutagenic activity of fast electrons from a 5-MeV betatron it is shown that, as concerns the elicitation of recessive sex-linked lethal factors in D. melanogaster, there does not exist a significant difference between fast electrons and x-ray radiations conventionally used for therapeutic purposes. For mature male generative cells as well as for immature germ-cells, the relative biologic activity is 1. If equal doses are applied, then the rate of mutation induced in immature germ-cells lies considerably below that induced in mature male generative cells. (CA 47: 6995b, 1955)


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 (5 MeV electrons and 200 kV x-rays) ranged from 1000 to 4000 r. The percentages of II/III 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 Brandt, H. von, Dürrich, W. INDIZIERTE BRÜCHEN DES RING-CHROMOSOMS X 28 VON DROSOPHILA MELANOGASTER NACH BÉTATÖRENNUNG MIT BÉTATÖREN UND SCHNELL ELEKTRONEN (Induced breaks of the X 28 ring chromosome of Drosophila melanogaster after irradiation with x-rays and fast electrons). Strahlentherapie 91 (1953) 149-61. (In German, but see ABC-9, 5478, 17.)

Meets of an X 28 strain of D. melanogaster were irradiated with various doses of fast electrons from a 5-MeV betatron and with x-rays (100 kV). Immediately after irradiation the males were bred with Berlin normal females. The F 1 generation produced by fully-developed spermatocytes exhibited a more or less marked deficit of females, the investigations covering a total of 350,000 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 0-6000 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.)

* Dürrich et al. 1950 - (1957)

818 Edington, C. W. THE DIRECT RADIATIONS OF DIFFERENT Kinds It has been shown that fast neutron radiation. Since these are more rapidly than one would expect as compared to fast neutron shown that the frequencies of mutants were significantly different. The response for x-ray-induced recessive lethal strains is an investigation was made of the effects on the induction of dominant lethal strains in Drosophila. These results on x-rays of different average ionisation: induction of both genetic effect (auth. summary).

820 Evans, T. C., Yu Yang Fu. K. SEYFROGS OF THE GRASSHOPPER Eggs of Melanoplus differential examined 3 weeks later, at which time they had hatched. The indications were that the larvae were measured in air with thin factor based on standard employ experiments were conducted at the neutron beam 133 and 1120 kV potential x-radiation a lower energy beam was used to give similar conclusions in the same qualitative aspects.

821 Frey, E. STRAHLENWIRKUNG (radiation effect of a 51-MeV 183-200). (In German)

Lethal dose curves were obtained x-radiation. In 8-day eggs 21-1 to 4-week eggs the curve of 3-5 x-rays, in 7-5 week eggs 51-3 MeV x-rays. (CA 20: 28652, 1972)

822 Füreis-Wiggle, H. ERSTE BIOLOGISCHE Experimente mit einem 3.8-MV betatron Drosophila melanogaster pupae. (5 h, 10 h, 22 hmental changes are detected)
Dittrich et al., 1980 - [899]

Dittrich et al., 1980 - [1182]

Bidrogoff, G. W. THE INDUCTION OF RECESSIVE LETALS IN DROPHILA MELANOGASTER BY RADIATIONS OF DIFFERENT ION DENSITY. Genetics 43, 6 (1958) 744-23.

It has been shown that fast neutrons are 1.6 times more effective than Co²⁹ γ-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 lineararity, the relative biological effectiveness for X-rays as compared to fast neutrons or γ-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.


An investigation was made of the effects of monochromatic 34-MeV fast neutrons and Co⁹⁹ γ-rays on the induction of dominant lethals and of 18-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 RBE of different radiations for the induction of both genetic effects studied is dependent on the LET of the radiations used. 34 references. (auth., summary)


Eggs of Melanoplus differentialis were irradiated on the 4th day of development (25°C). They were examined 3 weeks later, at which time the controls were in the diapause stage. Radiation effect was indicated 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-cw cyclotron, and was produced by bombarding a beryllium target with deuterons. The second was a field at the rear of the target (160° 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 rcp 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 LD₅₀ for the x-radiation was 290 and 297 r for the higher energy neutron beam 183 and 118 rep. and for the lower energy neutron beam 63 and 49 rep. Based on the 250 kV potential x-radiation as unity, the RBE of the higher energy neutron beam was 2.0 to 2.3 and that for the lower energy beam was 4.3 to 5.2. So far, the results of another section (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.


Lethal dose curves were established in eggs of various ages and compared with that caused by 180 kV x-radiation. In 4-h eggs 31-MeV radiation was slightly less effective than the x-rays. In 8-h eggs 31-MeV radiation was less effective than the x-rays. In 18-h eggs 31-MeV radiation is less effective than 3-MeV, both being less effective than x-rays. (Pb 29: 2802, 1952)


Drosophila melanogaster pupae of various ages were subjected to 50-150 kV and 31-MeV radiation. Pupae of 5 h, 15 h, 25 h and 40 h were given doses of 10,000 r, 86,000 r and 80,000 r. Relative developmental changes are described briefly.

201

Non-irradiated females of Drosophila melanogaster mated with irradiated males (200ø r) lay eggs which show different rates of hatchability depending on the time after mating. The peak of reduced hatchability lies between the 5th and 7th day. This effect must be caused not 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 KeV photons. (auth. summary)


The tests described consisted of determining the percentage of unhatched embryos in different periods after irradiation of the male parent. This and data from other tests proved the effectiveness of 30 MeV electrons and 30 MeV x-rays from a betatron in inducing dominant lethals as compared with ordinary x-rays. Four distinctly marked stages of spermatogenesis with different reactions to the type of radiation were distinguished. A strict dependence of the 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 46 h pupae and adult males), spermatocytes (in 0-2 h prospaxes 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-photonos, 10 and 30 MeV-electrons). The production of visible mutations, recessive and dominant lethal factors, chromosome losses, gametarchy, and translocations was tested. We found 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 dosage can be observed. There is no manifest influence of varying radiation qualities upon the genetically resistant 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 spermatogonia may be due to different oxygen tensions (depending on the cell function) and whether in different stages there are two types of induction of mutations (by the OH radicals and H₃O⁺).


Drosophila males were irradiated with 180 keV x-rays, 31 MeV γ-rays and 30 keV x-rays from a betatron. When developing sperms were irradiated quantitative differences could be observed. The low-energy radiation (180 keV) proved more effective in terms of translocations and chromosome breaks. Such differences were not observed in irradiating mature sperms where one assumes that it is mostly the free radicals which are effective whereas H₃O⁺ plays a highly active part in developing sperms. The lifetime of free radicals and the production of H₃O⁺ will depend on linear energy distribution (ionization density) which will differ with the type of radiation employed.
MORTALITY AFTER IRRADIATION, especially that of Atomic Energy.

Small females (3000 g) lay eggs which hatch.
The peak of reduced hatch-
noted not only by dominant lethal factors
show that spermatocytes and spermatogonia
in spermogenesis is very sensitive.

Goulden, M. E., Leemnes, K., Darden, E. B., Jr. FRAGMENTATION OF CHROMOSOMES IN GRASS-
HOPPER NEUROBLASTS BY BETA RAYS AND X-RAYS (abst.). AECD-1895, Oak Ridge National Lab.,
Tenn., 1 p.

Dissected 14-d-old embryos of *Chorophaga viridifacies* were exposed to 1.7 MeV 6-rays from 220 and
some to 15 kV potential x-rays, conditions for exposure being identical.
In both cases, a dose of 64 of x-rays and
70, 4 rep of 6-rays was used, the amount of energy dispersed in the tissue being equal for the two
types of radiation. The embryos were made into hanging drop preparations following irradiation and
placed at 20°C. At intervals of 64, 220, 294 and 556 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 6-irradiated cells.
The number of 6-ray induced double fragments observed in cells fixed 333 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 0.06 level. Since the mitotic rate of 6-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
analysed 333 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
18-20, 1952)

Goulden, M. L., Mir, M. A., Darden, E. B., Jr. EFFECTS OF BETA RAYS AND X-RAYS ON MITOTIC RATE
OF LIVING GRASSHOPPER NEUROBLASTS (abst.). AECD-1901, Oak Ridge National Lab.,
Tenn., 1 p.

14-d-old embryos of *Chorophaga viridifacies* were removed from eggs and dissected as for hanging
preparation.

Two doses of radiation were used, namely, 4, 8, 9 and 64 of x-rays and 8, 10, 14 rep of 6-rays.
Dose rates were adjusted so that the amount of energy dispersed 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 prepa-
rations following irradiation and the neuroblasts observed with a microscope enclosed in an incubator
maintained at 28°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
dose of radiation used do not affect it. Consequently, the number of cells going through mitosis in a given
period of time can be determined.

(Entire report. Abstract of paper for Atlanta meeting of Association of Southeastern Biologists, April
18-19, 1952)

Gluck, Melvin, L.R. ESTUDIO COMPARATIVO ENTRE UNA MASA DOSE DE RADIACIÓN GAMMA DEL
RÁDIO Y DE RAYOS X, DESDE EL PUNTO DE VISTA DE SU ACCIÓN BIOLÓGICA (A comparative study of the
same dose of gamma radiation of radium and of x-rays from the point of view of biological action).

In tests using *Drosophila*, 0.5% of the eggs were killed by 240 r 6-rays or 210 r x-rays.

(Entire report. Abstract of paper for Atlanta meeting of Association of Southeastern Biologists, April
18-19, 1952)

Groom, A. S., Sullivan, R. L., Leach, L. E. BIOLOGICAL RESPONSE TO MIXED RADIATIONS.
Nucleology 10, 64 (1927) 64, 66.

In reactor and certain accelerator situations radiation 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 8-emitters (32P and 32S) on the ecotropic virus, *Haplochromis lugubris*.

(Entire report. Abstract of paper for Atlanta meeting of Association of Southeastern Biologists, April
18-19, 1952)
Experiments with a 6-keV electron beam. The relative biological efficiency of fast electrons is compared to 200 keV x-rays, and data presented for x-ray and 1-MeV old Drosophila eggs and larvae.

Comparative effectiveness of x-rays of 244 keV and 50 MeV on Habronomala eggs (abst.). Radiation Res. 1 (1956) 499.

First mitotic metaphase eggs of Habronomala were used to test the comparative effectiveness of 244 keV and 50 MeV x-radiations. Eggs ranged from 100 to 175 μ in low-voltage work and from 100 to 160 μ for high-voltage studies. Failure of unfertilized eggs to hatch has been attributed to the presence of dominant and, in a lesser extent, of recessive lethals. Dose-action curves are approximately exponential. For test differences between the slopes of the two curves when these were plotted on a semi-logarithmic scale revealed no statistically significant difference. Variance analysis of data within dose and for each voltage of radiation showed that the data for each dose group were not being conveyed to the same information from experiment to experiment. Comparisons between dose for 244 keV and 50 MeV indicated that for a given dosage radiation of low and high voltage were revealing similar effects. A review of previous work by Waddington, et al., which the method was based on, led to the conclusion that x-radiation induced chromosome breaks, terminal deletions, and the formation of chromatid bridges in most of the eggs which died. Dominant lethals were initially responsible for failure of eggs to hatch as larvae. It is concluded that equivalent x-ray dosages from 124 keV and 50-keV machines appear to be equally effective in inducing lethals in Habronomala eggs treated in fast mitotic metaphase.

This study was reported in detail in the Amer. J. Genet. 26 (1955) 877-85.


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

Drosophila melanogaster and Drosophila melanogaster, by fast electrons and x-rays. (In German.)

D. melanogaster was exposed to a 3-MeV electron beam from a betatron and to 200-keV X-rays, such as is generally used in therapy, for the purpose of studying the effect of these radiations on chromosome mutations. With respect to the reciprocal translocations between the second and third chromosome that were covered by the analysis of the crossover, 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 difference was found between the effects produced by these two radiation of unequal differential localization. (Auth.)


Part of this work was published subsequently in Radiation Res. 1 (1950) 60.


Virgin females (500-540) were treated with a series of doses of x-rays, thermal neutrons, and fast neutrons. They were all mated, and their haploid sons (54432) were examined for eye-color mutations. Dose action curves for production of visible eye-color mutations by each of the three radiations were obtained. The shape of the curves is similar; each shows a linear-linear portion and that is a more rapidly 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 single hits, and that the proportion of 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 equation two-hit hypothesis, but in spite of the general resemblance of the three curves the x-ray data do not. With visible eye-color mutations in Monomorium as a criterion, the relative biological efficiency at higher doses is to be expected if many of the visible mutations are due to rearrangements and deletions. (Auth.)


Short-cut formulas are given for the (1-1) x (1-1) individual from a formula which is a fun.


Insect eggs were among the tissue, 72.8 radiation (A). (In parentheses). Two sets of 24 (50), partial irradiation. In case a single dose (a) the test studied for insect eggs. Egal.

Medical Research Council 19

Miscely, G.N., Visible An.. Fast neutrons from the Oak Ridge (about 1 MeV) appear more effective in the third chromosome by mutations are produced at 1/2. for all observed, visible band relative biological effective mutations likewise is quite about two-thirds as effective as the neutrons have an R of fast neutrons than per 2 of x-rays. It appears, therefore, radiations in Drosophila, the (An abstract of earlier work) of specific loci in the ch published in Genetics (1952) 32.


Matroo sperm of D. melanogaster Co gamma-rays of 250kVp. Males of wild type virgin. Radiation were detected in the statistically from those found per unit of dose in producing the effects of these agents as density of the path.

Short-cut 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 ß-radiation on mitotic rates in grasshopper nerve-blisters (Chorthippus viridissimus). (auth.)


Insect eggs were amongst the various types of biological material subjected to various doses of x-radiation, mixed y and ß-radiation (Fe) and pure ß (Pb). The insects were Bombyx mori and Scylla rostit (pharmacists). 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 fractional 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 the cold being observed, which also corresponds to the optimal interval for recovery. 

+ Lübbecke and Höller 1969 - [1028]

+ Lübbecke and Höller 1960 - [1028]

+ Medical Research Council 1957 - [1028]

Mickey, G.H. VISIBLE AND LEATHAL MUTATIONS IN DROSOPHILA. Amer. Nat. 98 (1964) 341-50.

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 r loci markers in the third chromosome of Drosophila melanogaster as are x-rays of 250 kev potential. Dominant visible mutations are produced at a much higher rate per re of neutrons than per r of x-rays, the RBE of neutrons for all observed variants being from 6 to 51 and for the proved dominant mutations from 3 to 20. 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 neutron have an RBE of 2. Dominant lethals are produced at a much higher frequency per re of fast neutrons than per r of x-rays, the RBE at lower dose 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 irradiations 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. Yauden was published in Genetics 53 (1959) 676-7.


Mature sperm of D. melanogaster (Oregon-R) were given doses ranging from 1500 to 8000 r of either Co60 gamma rays of 250 kev potential x-rays or from 150 r to 1000 r of fast neutrons. Treated males were mated to wild type virgin 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 2800 r and 500 r of 275 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 taller curves fail, more sharply with higher doses, to a gradually steady period of varying length, depending on dose. The percentage of sex-linked lethals after irradiation at 31 MeV and 175 keV (1000 r and 2000 r) are given, also the 2X2 curves. On the whole, the 2X2 is lowest during the period of highest mutational sensitivity.


An apparatus for external irradiation of flies with β-particles from a solution containing radioactive isotopes is described, and the biological dose of the source is reported. The apparatus has been used for obtaining the sex-linked recessive lethal mutation curve after irradiation with 280 keV β-particles, using a dose biologically equivalent to 500 r for the induction of dominant lethals in female sperm. The curve was found similar to the one obtained after 1000 r of x-rays. (auth.)

Muller, H. J. CHARACTERISTICS OF THE FAR STRONGER BUT "SPOTTER" MUTAGENICITY OF FAST NEUTRONS AS COMPARED WITH X-RAYS IN DROSOPHILA MELANOGASTER (abstr.). Genetics 29 (1944) 585.

Experiments of 1943 establish frequency of transformations connecting second and third chromosomes at approximately 9.8 x 10⁻⁶ per pair, practically independently of dose, for autosomes from either side of the Oak Ridge cyclotron as well as applied to minute spermatocytes in young males. This effectiveness is 5.4 times that of 4000 r x-rays, varying with x-ray dose (1/3). - NVE (neutron-x-ray effectiveness) in inducing male recombination, lacking either paternal sex-chromosomes or its maternal portion, was 5.5. However, subtraction of partial losses, estimated by tests, indicated that NVE for complete losses, presumably representing homologous segments derived from individual brains, was 5.5. Causes of lower NVE for somatic rearrangements than for individual brains are listed, - NVE for producing separately registered sex-linked recessive lethals is 5.4. However, for all visible changes of expression of specific loci, NVE was about 4. As it was for proved "point-mutations" of these loci (this holds also for female germ cells). This difference in lethals is caused by multiple neighboring effects with lethals, which hide some of point-mutation lethals, yet cause neutron-induced rearrangements to affect more loci than to give more "visiblener" than x-ray-induced rearrangements. (from abstr.)

* Neville 1965 - [1965]
* Paul and Schubert 1965 - [1965]
* Rieger et al. 1966 - [1966]


The comparison of the biological effectiveness of 100 keV radiation and 100 keV x radiation was made for three biological specimen, the specimen were fruit fly eggs, pea sprouts, and the top of the spouts of Vi feed. A large number of batches of fruit fly eggs, specially prepared and incubated, were irradiated with 100 keV x-rays and 100 keV beta. One set of batches was irradiated after 7 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 fatality vs. dose was thus obtained for each case. The 1-h irradiated eggs were much less resistant to radiation than the 3-h eggs. A value of 1.0 for the RI of 100 keV beta was obtained with the former and 0.86 with the latter by comparing the x-ray dose required to produce a 50% fatality.

The statistical uncertainty of the RI was different from 1.0. It did not dose required to reduce the rate of sprouts of Vi feed as well as on the biological speci with biological specimens to be chosen and clearly stated in medical methods. (RHA 1965)


New data have clearly confirmed that irradiation of spermatozoa may reduce to classical findings for β-particle radiation genetics. It was impossible at one time to perform radiation, rather than quality, confirming classical findings for β-particle radiation genetics. It was impossible to perform sex-linked recessive lethals but also intensity effect is on the mutation and obstruction is not a necessary result. Results can lead to other predictions and, at least under some circumstances, rates obtained with acute irradiations obtained with the present

Schmid, W. VERGLEICH DER 100 keV-ß-STRUMEN UND BEI DROSOPHILA MELANOGASTER BETATUN 180 keV X-RAY DROSOPHILA MELANOGASTER. 2.

In order to compare the biological incidence of brain sections were subjected to different x-ray sources (100 keV), homogenates of 0.9 factors, etc… Values for mutation rates and the present, to be no same irradiations used.

Sherriff, A.J. DIE ERZEUGUNG DROSOPHILA MELANOGASTER STRAHLEN (The response of x-rays and 100 keV x-rays).

The relative effects of 100 keV investigated on immature males for fertilization. The Muller-1 recombination was measured. Used with conventional rats, i.e., however, could not be verified quantitatively. Evaluation. If a stronger mutagenic action than the present, see ARS-ct-84:

Stone et al. 1964 - [1964]

Sullivan and Gosh 1965 - [1965]
The statistical uncertainty of these two determinations did not clearly establish that the RBE for $^{238}$U betas was different from 1.0. B did, however, in measurements of rate of growth of the species. The doses required to reduce the rate of growth by 50% yielded a value of RBE of 0.4 for both sets of promoter and the top of the promoters of $^{238}$U, $^{239}$U. It is concluded that the value of RBE depends on experimental conditions as well as on the biological species, that extreme care must be taken in any attempt to carry over results with biological species to the realm of human pathology, and that concrete experimental conditions must be chosen and clearly stated in determining the RBE in radiation-damage studies as well as in medicinal methods. (NSA 15; 1954, 1969)


New data have confirmed the earlier findings that specific locus mutation rates obtained with chronic irradiation of spermatogonia are lower than those obtained with acute x-rays. Since this result is in contrast 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 revealed the following: the lower mutation frequency is due primarily to differences in dose rate of radiation, rather than quality; a dose-rate effect is not obtained in experiments with mice spermatogonia, confirming classical findings for spermatogonia, and indicating that the explanation for intensity dependence in spermatogonia lies in some characteristic of gametogenic stage; and a dose-rate effect is found not only in spermatogonia but also in oocytes, whose cell selection is improbable, indicating that the radiation intensity effect is in 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 severe as those estimated from the mutation rates obtained with acute irradiation. However, it should not be forgotten that even lower mutation rates obtained with the present intensity levels are still appreciable. (Auth.)

346 Schmid, W. VERGLEICH DER GENETISCHEN WIRKUNG DER 31-KeV-BETATRONSTRAHLUNG MIT 100 keV-KURZSTAFFENSTRahlung DURCH ERZIEGUNG VON SEITENBEIN REZESSIVEN MUTATIONEN UND BEI DROSOPHILA MELANOGASTER. (Comparison of the genetic effectiveness of radiation from a 31 keV betatron and 100 keV x-rays in terms of the production of visible recessive mutations and gynandromy in Drosophila melanogaster.) (1958) 218-45. (In German)

In order to compare the biological efficiency of the 2 sources, some normal Drosophila males from a wild lab strain were subjected to 2000 r of $\alpha$-radiation (51 keV) and others to an equal dose from a conventional x-ray source (100 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 gynandromyms 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 radiation used.


The relative effects of 150 keV conventional rays and of fast 50 MeV electrons, both at 3000 r, were investigated on immature male gynocells of Drosophila melanogaster which were irradiated 5-11 d before fertilization. The Miller-5 method was employed, and the lethal and sublethal factors resulting in the F2 generation were counted. Using fast electrons, 6.97% lethal factors were obtained, compared to 5.15% with conventional rays, i.e., the mutagenic effect of fast electrons was 1.37 times stronger. This difference, however, could not be verified statistically. The number of sublethal factors produced was too small for quantitative evaluation. It may be presumed that fast 30 MeV electrons possibly have a stronger mutagenic action than 150 keV conventional rays. (Auth.)

(For translation see ABC-r 8443, tr. by Los Alamos Scientific Lab. 1959)

Sone et al. 1956 - [1068]
Sullivan and Groch 1958 - [1285]

Fifth or sixth instar grasshopper nymphs were used. In order to destroy every egg in each grasshopper ovary, with the exception of the most advanced, it was necessary to irradiate the total body with 560 r (200 kV) x-rays, 40 kbpCi gamma rays, or 22.5 r of fast neutrons. Thus, the relative biological effectiveness of Ca k- gamma rays: 200 kV x-rays: fast neutrons, for this specific effect, is 1:0.1:3.2:19. This is correlated with relative specific ionization and linear energy transfers. It is suggested that damage to the grasshopper ovary could be used as a biologic dosimeter for fast neutron doses in the range 10 - 15 r. The high antibiotic rate in the formation of the grasshopper egg within the ovariole may well be a major cause for its sensitivity to ionizing radiation.


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 chromosome abnormalities in Drosophila melanogaster and the destruction of egg nuclei of grasshopper (Melanoplus differentialis) nymphs.

(See also 852, Argonne Nat. Lab., Dec. 1955, p. 3.)


Experiments on the biological action of intermittent (so-called "ultra-fractionated") x-ray treatment showed that the effects become noticeable only when the elementary periods of irradiation and interruption 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%. A working hypothesis, it can be summed that the effect of a quantum is confined within the limits of an elementary target in a living cell last for a certain time interval; if another irradiates the same target before the expiration of that interval, the effect is increased; this is the case of a continuous irradiation. Experiments with 12-hr-old Drosophila pupae showed that the width of elementary targets is at least 0.1 mm (10 to 100 cells), and that the life effect lasts for about 3/500 s. (Auth.)


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 α, β, γ, 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 incomplete additivity of two types of radiation indicates some difference in the mechanism of action of the radiation. Complete additivity indicates that the mechanisms of action of the radiations are identical in their most essential feature, the promotion of the same deterministic 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 x-rays is the complete type. (NASA A: 2148, 1956)


The x-rays were generated at 200 kV and 5 mA and were filtered by 0.5 mm of Cu and 3 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 block in the University of Chicago cyclotron. The eggs were deposited in a lead-lined 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 γ-radiation. The LD50 of x-rays is 179 r, that of fast neutrons is 31 n, and that of the mixed cyclotron emission is 43 Vicomex, the apparent α/β ratio, from data: 1950.)

1-A-2 RAL

853 Abecia, E. A., Poteck, K. A. DROSOPHILA MELANOGASTER.

The development of dominant k alleles was investigated. Single k to 609 and to 1069 r, and 3 expr stages of spermatogenesis were used.

842 Alexander, L. M. RADIATION SENSITIVITY OF SPERMATOGENIC CELLS OF D.

The mutation rate, when calculated spermatogenesis with 600 r of x-ray sensitivity of the two types of cells account for the difference. The mutation is obtained with marked characteristic of spermatogonia.

854 Alexander and Simms 1955 - 1)

855 Brockway, A. P. THE EFFECTS OF MEALWORM, TEMENHRIO MOLT.

In preliminary experiment, due to the age of the larvae was no observable difference in effect 8 h after formation. The time period of larvae and also prev that the larvae are more given.

856 Brockway, A. P. THE EFFECTS OF MEALWORM LlLlR. (Ab logical Laboratory)

A genetically mixed culture of hatched normally, after 2000 i region between 1000 r and 2000 length of the pupal stage. Pop.
EFFECTIVENESS OF FAST NEUTRONS.
(MELANOPHIAL DIFFERENTIATUS).

The death rate for every egg in each grasshopper
must be translated to the total body with 250 r
of neutrons. Thus, the relative biological
effectiveness of this specific effect, is 1.01 ± 1.21.

The data is suggested that damage is likely to result
for fast neutron doses in the range
0 - 250 r per egg within the ovariole may well be

EQUIPMENT EFFECTIVENESS OF FAST
NEUTRONS.

Argonne National Laboratory has had the
Comparative effectiveness of the biological
biological materials, including the
inhibitory action of egg nuclei on germ-

LUCASFUR EFFETT DEFERMENS
Experimental study of the biological
sensitivity by irradiating with fast neutrons at
periods of irradiation and intermittent
irradiation as compared with that of a continuous
irradiation. It is shown that the effect of a quantum bit
is temporary if another bit of the same frequency of a
bit is given. This is the case of a
neutron that showed the width of elementary
lengths to be about 1/500 s.

ZEUS RADIATIONS. Amen. J. Bochender

RADIATION EFFECTS ON EXPERIMENTS BY THE AUTHOR AND OTHERS

EXPLORING RADON.

A summary of experiments by the author and others with
the mouse, mouse, mouse, mouse, mouse, mouse, mouse,
mouse, mouse, mouse, mouse.

FREE RAYS AND CYCLOTRON HYDROGEN.

A summary of experiments with the mouse, mouse,
mouse, mouse, mouse, mouse, mouse, mouse,
mouse, mouse, mouse, mouse, mouse.

I-A-2 RADIOSENSITIVITY OF ONE OR MORE
STAGES OF DEVELOPMENT

Abbeleva, S.A., Bochender, N.A. RADIOSENSITIVITY OF CHLORINE SPERMATOGENESIS BY
DROSOPHILA MELANOGASTER. A.A. Con. 1960, 6, 47.

The development of dominant bristles in irradiated 24-h-old Drosophila melanogaster sperm and spermatids was investigated. Single exposure to 500 r, 3 exposure to 500 r at 24-h-intervals, single exposure to 400 r and to 200 r, and 3 exposure to 600 r at 24-h-intervals were made. Radiosensitivity at various stages of spermatogenesis was evaluated. (NSA 15: 1959, 1961)

Abbeleva, L.S., Bochender, N.A. RADIOSENSITIVITY OF ABRUPT SPERMATOGENESIS BY
DROSOPHILA MELANOGASTER. (The radiosensitivity of different stages of spermatogenesis in Drosophila melanogaster). A.A. 92/5/1, 405, 1960, 1, 3.

The development of dominant bristles in irradiated 24-h-old Drosophila melanogaster sperm and spermatids was investigated. Single exposure to 500 r, 3 exposure to 500 r at 24-h-intervals, single exposure to 400 r and to 200 r, and 3 exposure to 600 r at 24-h-intervals were made. Radiosensitivity at various stages of spermatogenesis was evaluated. (NSA 15: 1959, 1961)

Alexander, M.I. RADIOSENSITIVITY AT SPECIFIC AUTONOMOUS LOCUS IN MATURE SPERM AND
SPERMATOGENIAL CELLS OF DROSOPHILA MELANOGASTER. Genetics 45 (1960) 1019-12.

The mutation rate, when calculated with point mutations, was higher in mature sperm than the rate for spermatogonia with 500 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 breakpoints 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 500 r. The absence of chromosome aberrations remained characteristic of spermatogonial mutants. (pout.)

Alexander and Stone 1955 - 1156

Brookway, A.P. THE EFFECTS OF X-RADIATION ON LARVAL AND PUPAL STAGES OF THE YELLOW
MELANISM, TENEREBRI MOLITOR LINN. Biol. Bull. 103 (1952) 366. (Paper read by title only)

In preliminary experiments, doses of 2500 to 6000 r were used on larvae of T. molitor 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 2500 to 6000 r 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 the formation of normal adults. In determining LD50 values, it appears that the lighter larvae are more radiosensitive than the heavier and presumably older larvae. Details are given.

Brookway, A.P. THE EFFECT OF X-RADIATION ON THE PUPAE OF THE YELLOW MELANISM,

A genetically mixed culture of larvae was used. All pupae were used as controls or given 300 r and 1000 r hatched normally. After 2500 r, only 33% did so. From 2500 r to 6000 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; 600 r increased it to 9.0 d, 6000 r to 10.2 d,
560 to 20,000 and 1 to 11. At 2000 the emerging adult was unable to shed the pupal cuticle. The hatching process of the new cuticle was incomplete in all adults irradiated with 3000 r at the pupal stage. Hatching was also observed.

Chandley, A. C., Batesen, A. J. MUTAGENIC SENSITIVITY OF SPERM, SPERMATOZOGONIA, SPERMATOZOGONIA IN DROSOPHILA MELANOGASTER. Heredity 12 (1962) 393-75.

F2 males irradiated with 1000 r x-rays were mated with different classes of females 1, 5, 8 and 11 d after treatment. The incidence of dominant lethals, hyperploids and translocations (structural changes) and recessive autozomal and sex-linked lethals (gene changes) were recorded for each day (tables and graphs). Estimates of induced crossing-over in the 4B or 5 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 mutant over those showing two mutants was used to estimate the proportion of "mutations" or small deletions. The pattern of sensitivity was similar for recessive autozomal and sex-linked lethals and translocations, showing a rise from the 2nd day (sporad) to the 6th (premeiotic) followed by a fall on the 8th (premeiotic at 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)

838


Results are reported on an investigation of the relationship between chromosome number and radiosensitivity of 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 at which the organisms were irradiated and cannot be correlated with gene number. No direct correlation was found between the radiosensitivity pattern and oxygen consumption, phosphorylase activity, nucleic acid changes, and canalic activity. (NRA 5: 819, 1954)

839

Clark, A. M. THE RELATION OF GENOME NUMBER TO RADIOSENSITIVITY IN HABROBRACON. (abstr.) Radiation Res. 1 (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 stage of the embryo, haploids are more radio-resistant than diploids. At later embryonic stages, haploids and diploids are equal in radiosensitivity. In the larval stage 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.

840

Clark, A. M. SENSITIVE PERIODS AND APPARENT FRACTIONATION EFFECTS IN IRRADIATED DROSOPHILA. Am. Nat. 92 (1958) 70-81.

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 800 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 marked in the fractionated group. Both translocations and lethals were significantly lower in the 4th and 5th broods of the fractionated series.

841


Haploids and diploids of the parasitic wasp Habrobracon were x-irradiated during known stages of embryonic and pre-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 haploid to diploid radiosensitivity is different for different stages of development. During cleavage stages of embryonic development haploids and diploids are equal in sensitivity; during the post-

842

embryonic stages diploids are more sensitive than haploids (NRA 5: 819, 1954).

843


The variation in the radiation was at embryonic ages from 1 to 6. r values are tabulated and show that...
embryonic stages diploids are more resistant than haploids. The bearing of these data on determining the size of injury from radiation is discussed. (auth.)

Clark, A. M. THE RELATION OF GENOME NUMBER TO RADIOSENSITIVITY. TID 063, Delaware Univ., Newark. 7 June 1960.
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 diploids of Habrobracon. NCSA 14: 1529-1530.

Habrobracon prepupae and pupae were exposed to x-radiation, and the lethal effects of the radiation were studied. Eclosion ratios show that x-rays have a greater lethal effect upon haploid males than upon diploid males. 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 eclosion ratios was obtained for adults given the same total dose but at different intensities. The response, therefore, seems to be dependent on intensity. Comparison of adults developing from radiated prepupae and pupae showed that a greater number of haploid males show structural malformations than diploids irrespective of sex and that the haploids show 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 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. Diploids 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 5 to 6 d. The increase in resistance for diploid pupae is identical with the haploids; the older diploid pupae (7-8 d) do not, however, increase as rapidly in resistance. The deleterious effect of radiation on somatic tissues is interpreted to be due primarily to injury to the genetic mechanism. (auth.)

Haploid and diploid embryos of Habrobracon 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. Embryo x-rayed during cleavage of early blastemas are deformedly affected during the egg stage but 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 radiation sensitivity of Locusta embryos was studied with various x-ray source exposures at embryonic ages from 1 to 6 d. The D50 was determined as a measure of the sensitivity. These values are tabulated, and show that the resistance to irradiation increases rapidly with the age, varying.
from an ED50 of 130 r on the 1st day to 8500 r on the 8th 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 Habrobacnota juglandis (Ashmead), and a figure is shown which gives the shape of the pattern of radiation-induced effects for most of the life-cycle, to demonstrate the divergence between sterilizing and lethal doses. (Doses of up to 18,000 r at 500 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 Habrobacnotagus 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 eclosed, and egg hatchability and longevity. On the basis of longevity, the wasps were damaged by a 300 r exposure, with a striking effect at a 2000 r-dose.

* Fritz-Niggli, H. MÖGLICHE URSCHEIN DES VERSCHIEDENEN STRAHLEMERDURCHFLEDERN DES DERMATOMA IN KREBSZELLEN UNTERSCHIEDLICHEN ALTERS. (Possible causes of the differences in radiosensitivity of genetic material observed in germ cells of different ages.) Naturwissenschaften 45 (1958) 557-64. (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 1958 - [3111]

* Heidenhain 1953 - [598]

970 Luses, W. M., Quartet, H., Chase, H. R. REDUCTION IN FACET NUMBER IN BAR-EYED DROSOPHILA BY X-RAYS. Genetics 38 (1953) 488-98.

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 20°C, which were irradiated with x-rays of dosages varying from 115 to 1640 r, developed into adult flies whose compound eyes had a smaller number of facets than unirradiated controls. With a dosage of 320 r the effect of the x-rays was largely confined to a radiosensitive period extending from about 86 to 150 h after 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. It makes 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.

* Listing 1954 - [3400]

* Listing 1956 - [1288]

* Listing and Jonsson 1956 - [1210]

* Listing and Jonsson 1957 - [1051]

871 Mak南海, V. M. PHASE CHERS IN THE CELL AND BRADATION, FROM A STRONG GRASSHOPPER (PODIINA BAKKK Zool. 1, 2 (1959) 657-68.

872 Nishiwaki, T., Toramaduku, S. ON THE EGGS AND SWARM OF A. The lethal effects of x-rays on g pillars, were studied. The x-ray ED50 in fertilized eggs was 500 r change in radiosensitivity was observed. Lethal mutations in females accompanied by high rate of unfertilized egg seemed to be more sensitive to x-rays.


874 Peth, W. N. SOME EFFECTS ON (ab.) PROC. B. ent. Soc. 10

875 Ray, D. T. X-RAY SENSITIVITY 591. Female wasps were treated with and set with host passes of the D. intervals. Eggs laid at successive (m)ag. Stages. Eggs laid with since the females were unmated females in comparison to controls indicate that while the fecundity was then in females it was much less in females. A more accurate investigation during the summer chamber technique latter not (Abstract of paper presented at Aug. 26 to 28, 1957)

876 Ray, D. T. SENSITIVITY OF D p. 290 in "Proceedings of the 10 University of Toronto Press. 105 Female M. wasps were


The lethal effects of x-rays on sperm and unfertilized eggs of mosquitoes, Aedes togoi and Culex pipiens pallens, were studied. The x-ray dose was 100-1000 r and the dose rate was 68-115 r/min at 60 kV potential. LPs in fertilized eggs was 50% in Aedes togoi and 150 r in Culex pipiens pallens. A marked discontinuous change in radiorrespondance was observed in fertilized eggs between 2-3 h 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 300 r. Sperm seemed to be more sensitive to irradiation in vitro than unfertilized eggs. (RA 28, 2866, 1964)


Rozenberg exposure of larvae and pupae of Drosophila melanogaster causes the destruction of part of the cells of the imaginal disk, the rudiments of the eye organ of the insect. X-ray irradiation is the result of the incomplete repair of this injury. The degree of repair depends upon the time of repair. The data obtained permit one to give a new interpretation of the concept of the sensitive period in ontogeny. The stage for which the repair process caused by the irradiated injury coincides with the sensitive period for a given indication, for a given neural influence. The destruction of part of the differentiated cells and the deviations caused by it in the further course of ontogeny are obviously a general characteristic 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.)

Covey 1999 - [1047]


Female worms were treated with x-rays of different dose (1000 r = 1500 r = 2000 r = 3000 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 mitotic and even pro-mitotic phases. Eggs laid within 6 h after x-ray were rayed during the first mitotic metaphase. Since the females were isolated, they produced all haploid males parthenogenetically. Offspring females were compared to controls furnished a rough estimate of the presence of lethal. Results seem to indicate that while the frequency of treated females decreased with the increase of x-ray treatment, as expected, there was a drastic decrease in the number of offspring from eggs laid the first 6 h after treatment 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 mitotic metaphase to high doses of radiation with sensitivity decreasing in the earlier meiotic and pro-mitotic phases. A more accurate estimate is being made by x-ray 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 16th meetings of the Genetics Society of America, Stanford, California, Aug. 26 to 29, 1957)


Female Mormonella worms were irradiated with various doses (500 r = 1000 r = 1500 r = 2000 r = 3000 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 mitotic stages. Eggs laid within 6 h after irradiation have been x-rayed during the first mitotic metaphase. Egg contents were made using the drum chamber technique. Because of the parasitic nature of Mormoniella, an accurate count of eggs can only be made by removing them from their host. The counted eggs must be 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 stung pupae and the eggs inserted within. The pupae were then placed in open vials and suspended by metal racks over a saturated solution of NaCl in large covered jars, to ensure the correct humidity and discourage mites. 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 4 h decreased drastically. Only 5% of those eggs from females given 1000 r developed as against 20% of eggs laid after 24 h. No eggs developed from wasps given dosages above 1500 r. This group reveals 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 mitotic metaphase to irradiation, with the sensitivity decreasing in the earlier meiotic and premeiotic stages.


An attempt is made to find the time of appearance of sperm irradiated in semen by a direct method, and at the same time to correlate it with the sensitivity pattern. It could be shown that the treated mitotic cells become available for insemination during the 7th day after irradiation and onwards. The peak of sensitivity would appear to correlate with cells treated during metaphase 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, 5, 8, and 12 h and 4, 6, 7, 8, 9, and 10 to 258 and 350 r. The variations 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 dose levels had essentially the same effect. The results showed that the radioreistant stages are characterized by zero (0) or slow (16 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. (NISA 15: 8500, 1963)

Tuljagina, N. M., Antonova, E. L. ПОВЫШЕНИЕ УСТОЙЧИВОСТИ ПЕТЕЛЯ СТРЕПТОЦИДА ЧЕРНЯ ЭМНЯ ИЗИМИЕОВОГО ЧЕРТ РОКОВУХ МОРЯ (DROSOPHILA MELANOGASTER) К КИНЕТИЧЕСКОМУ ИЗИМИЕОВОГО РАДИАЦИИ. Биологическое 3, 2 (1958) 197-205.


The radio-resistance of silkworm embryos in the stages from diapause to middle spring development increases with the degree of polyplody, other things being equal. There is a marked rise in resistance between diploid and triploid, and a smaller rise between triploid and tetraploid. The data support the ideas as to the essence of the biological effects of ionizing radiations. They show that the rate of increase of such effects as radiation damage to embryos of multicellular organisms are generally dependent on the cell number.

Ulrich, H. BÖHNENTUBULUSSTRahlung VON DROSOPHILA MELLONELAGASTER (Partial x-Irradiation of Drosophila eggs). Naturwissenschaften 36 (1951) 211. (In German)

Drosophila eggs 1 h after being laid were irradiated with 200 r of x-rays. By using a screen with a split-like window it was possible to investigate the influence of irradiation on 5 successive cones each 0.1 mm wide. A maximal sensitivity, expressed in percentages of no-hatchability, could be established for the second region of the anterior half of the egg. (EM 14, 71, 32, 1953)

Ulrich, H. EMBRYONISCHE EREEDON DER INZESTION. Uber exposing different portions of the egg to x-rays, it is demonstrated a non-mutation of the egg, effect similar but somewhat shifted of the egg, with a maximum effect at 21 to 22 h and 23 h instead of 24 to 25 h. No adults were produced.
transferred to new host pupae at
had been irradiated at different mlieotici
are the first metasomal type. Egg
separate cultured in a "w" with a
the eggs of "w" were then stored for
within. The pupae were then
and kept in boxes for about 2 weeks.
ences were noted in the groups and
incubation at 25°C was made.
the number of eggs hatching decreased
from eggs laid during the first 6 h
1000 eggs in this group. Reduction in the
to determine whether or not
resulting in a decrease in the sensitivity.

1. STAGES IN MALES OF DROSOPHILA


The irradiation of Drosophila eggs by using a screen with a split-like structure at successive zones each 0.1 mm wide, could be established for the second

By using a screen with a split-like,

A dose of 2000 rad did not destroy all pupae and adults in wheat grain. A dose of 1000 rad applied within

The number of eggs that developed from those of S. graminis and their larval pugnacity by 40 and 25%, respectively.

Irradiation of the 1st and 2nd instar larvae of both species at 1000 rad had little effect on the number and

...
In both species 5000 rad prevented the development of adults when applied to the 2nd 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 T, (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 pretreatment starvation reduced resistance to radiation injury. Free-feeding after irradiation lengthens 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 time 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-2 RADIOSENSITIVITY OF DIFFERENT SPECIES OR STRAINS

* Baker et al. 1953 - [239]
* Baker et al. 1954 - [241]
* Baker et al. 1955 - [240]
* Baker and Edington 1952 - [230]
* Bonnet and Pardee 1956 - [979]
* Bonnet and Pardee 1960 - [980]
* Bonnet and Rehakovsky 1960 - [982]

The LD50 of gamma radiation from Co60 against the body louse (Pediculus humanus humanus L.), house fly (Musca domestica L.), American cockroach (Periplaneta americana L.), German cockroach (Blattella germanica L.), bed bug (Cimex lectularius L.), and Phthirius and (Lepirhochea ornatulus L.) ranged from 130 r for half-day old fly eggs to 100,000 r for body louse nymphs and Phthirius and 8000 r for adults. Doses required to cause 100% mortality ranged from 600 r to 200000 r. Among the species tested, the LD50 varied inversely with the size of the insect. Reproduction in body lice was inhibited at dosages of 70,000 r or higher. DDT-resistant body lice were as susceptible to gamma rays as non-DDT-resistant lice. (auth.)

889 Cornwall and Buxton 1958 - [1204]

For abstract only, see 891.


A comparison was made of the radiosensitivity of Calandra granaria L. to gamma rays from Co60, 60Co, and 137Cs. The results indicated that the dose level of 10000 r of Co60 might be feasible for killing the insects. A comparison was made of the radiosensitivity of Calandra granaria L. to gamma rays from Co60, 60Co, and 137Cs. The results indicated that the dose level of 10000 r of Co60 might be feasible for killing the insects.

A comparison was made of the radiosensitivity of Calandra granaria L. to gamma rays from Co60, 60Co, and 137Cs. The results indicated that the dose level of 10000 r of Co60 might be feasible for killing the insects.
THE LONGEVITY OF THE COCK-ROACH AND FOOD INTAKES.

The technique for irradiating the species is as follows: the adult cockroach is exposed to 10,000 rads. The longevity increases with age, as 60% mortality occurs in irradiated cockroaches younger than males. Survival is improved when the feeding is reduced to 10,000 rads. The effects of irradiation on the longevity of the male are greater than those of the female. The results are discussed with a view to radioactive sensitivity with age.

Radiation on Some Insects

The radiation exposure dose was 10,000 rads.


A comparison was made of the susceptibility to γ-radiation of adults of 5 laboratory strains and 30 wild strains of Calandra graminis L. with that of the Peruvian strain, used as a standard. It was concluded that the index level of 16,500 rads evaluated for the sterilization of large populations of the standard strain of C. graminis might safely be recommended for the commercial sterilization of naturally occurring populations.


The paper forms a contribution to present knowledge of the reactivity 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 optimum conditions for the species. The effects of radiation on the complete life-history of a laboratory strain (Peruvian strain Laboratory, D.S.I.R.) of the grain weevil, C. graminis, were examined at 24-hourly intervals during the life-history. Each stage of development was subjected to 18 doses ranging from 250 to 50,000 rads. 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. graminis include: (1) radiation susceptibility of the sexes and (2) periodicity in fertility at sub-sterilizing doses. Doses evaluated for commercial sterilization are tested against massive populations and under a limited range of commercial storage conditions. The relative merits of fumigation treatment and radiation sterilization are compared.

(This paper was published in full as AEIR R. 1063, Atomic Energy Research Establishment, Harwell, Berks, England, 1959, 53 p.)

- T. H. S. 1967 - [1214]
- T. H. S. 1968 - [1211]
- Hassett 1967 - [1255]

3. **Ewer, P. T., Cocklin, P. M., Burwell, L. R.** RADIATION EFFECTS ON DIFFERENT STRAINS OF DROSOPHILA MELANOGASTER (Diptera: Drosophilidae) Genetica 41 (1969) 517.

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

- Kaufmann et al. 1960 - [2103]
- Kihara 1960 - [2641]
- Lee 1966 - [1019]
- Lee 1968 - [1260]
- Mithiwal et al. 1963 - [7822]


Раздел 1. Радиогенез, биологическое действие ионизирующих излучений, в том числе...

A. Variation of lethal dose from ionizing radiations with age.
B. Dependence of radiosensitivity on the type and quality of the radiation.
C. The mechanism of radiosensitivity, influence of metabolism and protective substances.
D. Comparative radiosensitivity during metamorphosis, catabolism, division of cells and during differentiation.

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

a) Ionizing radiation for controlling insects infesting food stuffs.
b) Ionizing radiations for controlling Caillouss.

The series of ionizing radiation has been studied on a number of insect pests: Calandra (Crotaphis) granaria, C. oryzae. Tribolium confusum, Tribolium rapa, Oryzaephilus surinamensis, Tribolium castaneum, Lasiodes sp., Acrothoaeis sp., and others. All experiments show the similarity in the effect of different kinds of radiation and the inexpediency of using high doses (>10,000 r even higher), as with 20,000 r 100% of insects are only killed. 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) [1063]


(see later article in Ecology 40 (1969) 572-9 for full account)


A preliminary study. The life history of Caloletus mycophagus (poxy) is presented in detail (life-cycles 4-9 d). Paramphius mappaena (predator) has a life-cycle of 30-40 d. A Co-60 radiation chamber was used, the doses delivered ranging from 350-1070 r at 19-20 r/hr. 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. E. mappaena eggs are innumerate to doses producing 50% mortality in C. mycophagus eggs of comparable age (D50 for Caloletus egg = 2900 ± 75 r).

Russell 1956 - [1063]

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


1. Genetical radiosensitivity of miye in the presence of dominant lethal mutations, namely, chromosomal and nonchromosomal.


The genetic radiosensitivity of mice, determined from the rate of formation of dominant lethals in single doses of 10-100 r, is less than for D. melanogaster. The dominant-lethal mutation rates in mice and Drosophila are directly proportional to the overall chromosome size of the species.

(See also report received from Moscow, USSR. by the US Committee on the Effects of Atomic Radiation, AJAC 63/60, 415, 1963, 11-p.)

892 Stremlens, E. X-RAY INDUCED LETHAL MUTATIONS IN SEVERAL STRAINS OF DROSOPHILA MELANOGASTER. Hereditas 97 (1951) 509-519.

Males from 51 strains of D. melanogaster were tested in regard to their sensitivity to the induction of dominant lethal mutations by 2000 r X-rays. Genetic differences in the sensitivity to induction of dominant lethal mutations by X-rays were found to exist between unrelated strains. (SSA 6: 770, 1959)

893 Stremlens, E. STOCK DIFFERENCES IN X-RAY MUTATIONAL SENSITIVITY PATTERN OF DROSOPHILA MELANOGASTER. Hereditas 97 (1951) 521-539.

These may be ascribed to differences in metabolic and maturation rates in the two stocks tested (Bo-Adiemark and Obo).


In 4 experiments a new method for the determination of the number of chromosomes was used in the form of numerical radiographic analysis of the sex chromosomes. The difference between the dose of 20 kr and 1000 kr was statistically significant. The number of chromosomes was determined by X-radiography with the help of a specially developed apparatus. The chosen form of treatment was the most effective in determining the number of chromosomes.


1. Genetical radiosensitivity of miye in the presence of dominant lethal mutations, namely, chromosomal and nonchromosomal.


The genetic radiosensitivity of mice, determined from the rate of formation of dominant lethals in single doses of 10-100 r, is less than for D. melanogaster. The dominant-lethal mutation rates in mice and Drosophila are directly proportional to the overall chromosome size of the species.

(See also report received from Moscow, USSR. by the US Committee on the Effects of Atomic Radiation, AJAC 63/60, 415, 1963, 11-p.)

892 Stremlens, E. X-RAY INDUCED LETHAL MUTATIONS IN SEVERAL STRAINS OF DROSOPHILA MELANOGASTER. Hereditas 97 (1951) 509-519.

Males from 51 strains of D. melanogaster were tested in regard to their sensitivity to the induction of dominant lethal mutations by 2000 r X-rays. Genetic differences in the sensitivity to induction of dominant lethal mutations by X-rays were found to exist between unrelated strains. (SSA 6: 770, 1959)

893 Stremlens, E. STOCK DIFFERENCES IN X-RAY MUTATIONAL SENSITIVITY PATTERN OF DROSOPHILA MELANOGASTER. Hereditas 97 (1951) 521-539.

These may be ascribed to differences in metabolic and maturation rates in the two stocks tested (Bo-Adiemark and Obo).


In 4 experiments a new method for the determination of the number of chromosomes was used in the form of numerical radiographic analysis of the sex chromosomes. The difference between the dose of 20 kr and 1000 kr was statistically significant. The number of chromosomes was determined by X-radiography with the help of a specially developed apparatus. The chosen form of treatment was the most effective in determining the number of chromosomes.
The article may also be found in: Zym. Res., No. 18 A 107 (1963)

I-A-4 RADIOSENSITIVITY AT THE CELLULAR LEVEL

Survey

Comprehensive review of the action of high-energy radiation as compared with ultraviolet radiation, in terms of mitotic morphology and cell viability effects, and their possible implication. Among the examples cited is work on grasshopper (Chorthippus) and Prosopis. The extensive literature (P. 819-924) goes back to the beginning of the century.

Differential effect of radiation damage to nucleus and cytoplasm, resulting from their specific functions. Evidence from experiments on Proryd (Oedaleus bioculatus) and Priory. Oedale biologica, 63, 1 (1958) 36-48.

A study on grasshopper (Locusta).

Differential effect of radiation damage to nucleus and cytoplasm, resulting from their specific functions. Evidence from experiments on Proryd (Oedaleus bioculatus) and Priory. Oedale biologica, 63, 1 (1958) 36-48.

A study on grasshopper (Locusta).
integrated as indicating that, in this cell at least, the first half of polyphosphate does not operate solely on energy stored within the cell but is dependent on an outside source of energy for continuance of mitotic activity. 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 yolks than in those of embryos cultured without yolks. The pronounced positive effect of yolks on recovery of neuroblasts from radiation damage demonstrates that. In this call, some extracellular substance or substances can greatly enhance repair of mitotic damage. (BA 55: 11548, 1956)

* Gaulden, M.J. EFFECTS OF LOW-LEVEL RADIATION (1 to 3%) ON MITOTIC RATE OF GRASSHOPPER NEUROBLASTS. CERN-2295, Oak Ridge National Lab., Tenn. (Part of Semiannual Progress Report for period ending 31 Dec. 1962 of the Biology Division).

It would appear that low doses of radiation affect mitotic rate in the grasshopper (Chortophaga viridifasciata) neuroblasts not by inhibiting DNA synthesis but by altering in some unknown way the physical structure of the chromosomes. 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. (GA 55: 11548, 1956)


Cytological and cytochemical studies were made on embryonic nuclei of the grasshopper, Chortophaga viridifasciata, after x-ray doses of 5000, 10000 and 15000 r. The changes were measured photometrically by using (1) the Feulgen reaction to determine relative changes in the deoxyribonucleic acid (DNA) concentration, and (2) the methyl green stain to indicate the degree of polymerization of the nucleic acid. X-radiation caused swelling of the nuclei. After correction was made for this, the Feulegen-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: 9534e, 1952)


In order to study the effect of radiation on larvae o D. melanogaster, various imaginal discs and organs of 3rd instar larvae were cultured in a synthetic medium together with cephalic complexes as a source of the metamorphic hormone. Irradiated discs or organs were used for culture in one series, and irradiated cephalic complexes were used in the other. From the data obtained in the two series, it was concluded that the decrease in % ecdysis was caused by a functional disturbance of the cephalic complex induced by radiation. It was shown that the brain, wing disc, and the testis were more radiosensitive than the eye disc, the leg disc, the salivary gland, and the fat body. (auth.)

Horikawa, M., Sugahara, T. STUDIES ON THE EFFECTS OF RADIATION ON LIVING CELLS IN TISSUE CULTURE. II. RADIATION SENSITIVITY OF CELLS ISOLATED FROM VARIOUS IMAGINAL DISCS AND ORGANS OF LARVIAE OF DROSOPHILA MELANOGASTER. Radiation Res. 16 (1960) 820-831.

In the present experiment, from the degree of incorporation of radioactive thymine C-14 into single cells isolated from irradiated larvae, differences in radiosensitivity of their constituent cells were found corresponding to the previous results. The ratio of C-14 incorporation into the whole tissue compared to DNA was highest in the cephalic complex, which may indicate an increased metabolic activity of the epidermis. The primary sites of the radiation attacks were the large and the 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.)

Howard, A. INFLUENCE OF RADIATION. (1955-6) Symposium on "C. M. E. Interference with DNA Synthesis. The effect on the radiosensitivity of DNA changes in cell populations caused by radiation. The work by Gaulden on the grasshopper shows that in a hyperactive cell radiosensitivity is further raised after a certain minimum dose."

Kaschman, B. R., McDowell in CELLULAR MATERIALS. 8. Cytoskeletal methods were used for dividing cells. In the mus and Chortophaga viridifasciata halve of the embryos, w salivary gland cells of larva trypsin, with water, a been exposed to x-raying for 1-2 days. (auth.)


A cytological study was made of cells from a C121-cell culture. Many severely damaged cells were reduced to 20% of the control induced disturbances of cell division. (CA 65: 9534e, 1965)

Levine and Gaulden 1956

Lindberg and Gaulden 1956

Moore, W. A. STUDIES ON CHROMOSOME Cytology and Cytology. The effect of X-radiation has been studied. The degradability of the chromosomal damage to enzyme molecule of biological activity. (auth.)

Ozawa, T. E. SUGGESTED BY HAVING USEFUL CHEMICALS. In the present experiment, from the degree of incorporation of radioactive thymine C-14 into single cells isolated from irradiated larvae, differences in radiosensitivity of their constituent cells were found corresponding to the previous results. The ratio of C-14 incorporation into the whole tissue compared to DNA was highest in the cephalic complex, which may indicate an increased metabolic activity of the epidermis. The primary sites of the radiation attacks were the large and the 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 radioresistance of DNA metabolism. Radiation-induced changes in cell population, and the results of changes in cell populations are described. Mention is made of mitotic delay in grasshopper neuroblast caused by radiation. The significance of the findings is considered. In the discussion, Hollowell cited work by Gaulden on the grasshopper neuroblast, where radiation effects were counteracted by placing the neuroblast in a hyperosmotic solution immediately after irradiation. Experimental details were described. Reference was further made to work by Harrington and Kuma 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 caused by ionizing radiation in nucleoprotein of dividing cells. In the studies on grasshopper embryos (Melanoplus femur-rubrum, Tribolium castaneum, and Chorthippus viridis) comparisons were made between irradiated and nonirradiated (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 a specific solution of trypsin, with water, with a solution of electrolytes, and finally with water when the larvae had been exposed to ionizing radiation, demonstrating that structural nucleoproteins were partially degraded by x-rays.


A cytological study was made of ovaries from 12-day-old flies, irradiated with 4000 r (about 100 r/s) of γ-rays from a Ca14 source shortly after emergence. Irradiated and control ovaries amounted to about 500. Many severely damaged oocytes underwent pyknotic 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 Amst. Rev. 258, (1957) 616, abstr. 14)


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 stability of the irradiated samples to trypsin with a specific inhibitor (NIH). 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)

SUGGESTED MECHANISM UNDERLYING THE DIFFERENTIAL RADIOTHERESISTIVITY OF CELLS HAVING CONDENSED CHROMOSOMES. Genetics 42 (1957) 347.

Both spermatids and spermatocytes have condensed chromosomes, found to be the most radiosensitive state in many organisms. The differential radiosensitivity found in Drosophila melanogaster spermatids and spermatocytes was investigated by x-irradiation in nitrogen, air and oxygen of spermatids, and of mature spermatocytes in 3-4 day-old males and in 2-day-old females with 1200 r and 2800 r (both single and fractionated doses). In spermatids, O2 produced no appreciable effect over air but N2 lowered radiation effects (autosomal translocations) considerably. In spermatocytes, 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.)

Includes tests with preparations of grasshopper embryos. (see application of technic in study of alpha-particle dosimetry and the inhibition of mitosis in the grasshopper neuroblast by low dosage alpha-radiation, Radiation Res. 17 (1955) 58-61.


Polonium alpha-particle sources and a microscope-adapter source holder were utilized for irradiating special 100a millimetre hanging-drop, living culture preparations of grasshopper embryos. The technique is described in some detail. The effects of 20 rad of alpha-radiation on the mitotic rate of grasshopper neuroblast cells were determined. Comparison with similar studies of beta- and X-ray inhibition indicated that alpha-particles were most and beta-particles least effective in inhibiting mitosis. A comparison of inhibition of the midprophase and late prophase stages by beta-rays and alpha-particles (20 rad) showed greater radiosensitivity in early midprophase, the effectiveness of each radiation becoming comparable by prophase. At this dose level, alpha- and beta-radiation effects on early and late prophase are indistinguishable in terms of mitotic inhibition or failure to inhibit division.


Dose-harassability experiments were conducted on newly laid eggs of Habrobracoon irradiated by a polonium-210 alpha-particle source. Latently is induced by the passage of one alpha-particle through the nucleus. From target considerations, it is concluded that an alpha-particle must pass through the nucleus to induce lethality. It is unnecessary to assume that lethality is caused by diffusion of "mutagenic substance" from the irradiated cytoplasm to the nucleus. Dose-action analysis of the different species of morphological appearance of dead embryos suggests that different modes of death from nuclear irradiation are independent of origin. (auth. summary)

923 St. Amant, W.  DIFFERENTIAL FREQUENCY OF ACENTRIC FRAGMENTS INDUCED IN GRASSHOPPER NEUROBLASTS BY X-RADIATION AT KNOWN MITOTIC STAGES. Genetics 26 (1939) 588-59.

The x-ray sensitivity of the stages of mitosis were determined in hanging-drop preparations of neuroblasts of the grasshopper, Chorthippus viridissima (DeGeer), at 25 ± 0.5°C. Cells were mapped and identified as to stage of mitosis just before treatment with 32 r of x-ray. The mapped cells were examined immediately after treatment and then re-examined at short time intervals for as long as 9 h to detect acrocentric fragments as the cells passed through subsequent anaphases. All determinations were made in living, unirradiated, cells at the first anaphase following treatment. The highest frequencies of fragments are found in cells treated in middle and late anaphase and telophase. The sensitivity of cells in interphase at the time of treatment is slightly lower than that of cells irradiated in early prophase. The number of fragments induced decreases from early to late prophase and reaches a minimum in cells irradiated in prophase. During metaphase and early anaphase sensitivity increases to reach the anaphase-telophase peak.


924 St. Amant 1958 - [1229]

925 St. Amant, W. X-RAY-IN NEUROBLAST AND IN THE EMBRYO.

The response of the actinum in forms there is an initial decrease in the.Effects of X-rays on both mitotic and non-mitotic stages of mitosis in the neuroblast and embryonic cells have been examined. The results indicate that the embryonic cells are more radiosensitive than the neuroblast cells. (This work was also published in Amer. J. Hum. Genet. 10: 70-8, 1958.)
sensitivities. Middle telophase (most sensitive) is about twice as sensitive as early late prophase (least sensitive).


The response of the neuroblast tumor cell to x-rays is identical to that of the grasshopper neuroblast. In both cases there is an initial decrease followed by a compensatory rise in mitotic activity. Maxima of chromosomal effects correspond to maximum of mitotic inhibition. The neuroblast study, in which cells in known stages of mitosis were irradiated, shows 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 meta- or anaphase at any given time after treatment. The admissibility 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) inversion 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)


Using living, unirradiated 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 chromosomal breakage induced by 32 or 33 of x-radiation. The stage of mitosis at the time of irradiation is known for all cells from direct observation. The sensitivity curve of chromosome breakage shows 3 maxima (middle prophase and middle telophase) and 2 minima (anaphase and very late prophase). The sensitivity curve relating mitotic stage to chromosomal 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 meiosis.


D. viridis males, 15 to 30 h. after eclosion, were irradiated with 2000 r/h for 1 minute at 0-5°C in different gas environments. The number of dominant lethals and translocations induced in cells which were in different stages of spermatogenesis were scored using sequential multiple mating over a three-week test period. The stages from meiosis through spermiogenesis 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. Lethals were irradiated in air 1-2 h 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 term 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. (SA 30: 1819, 1954)


Metaphase differential emulsion were used. The effect of 5000 r of x-rays can be kept latent for 6 months by maintaining the eggs at 90-94°C temperature. When the eggs are irradiated and immediately placed at 0°C, and are then maintained for 6 months a definite and physiological changes are observed upon returning them to 24°C. However, pyknosis occurs by 8 d at 24°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-4498, Argonne National Lab., 1950, 169 p., and as Nuremberg publ. 154 in Anal. Record 138: 72-4, 1956)
Prior to induction, cells in the grasshopper embryos are very susceptible to x-irradiation. A cell that has responded to the x-rays, although it is undifferentiated morphologically but differentiated physiologically, is not easily affected by x-irradiation. Before induction, the ability of cells to differentiate into tissues 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 Habrobracon 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 cytoplastic effect. In the Habrobracon egg, this cytoplastic injury is constant without respect to dose or incidence and complete lethal actions, 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) 159-60, under the title "The non-induction of mutations by x-rayed cytoplasm")


Irradiated cytoplasm of Habrobracon eggs was found to function normally after exposure to doses of x-rays many times greater than that lethal to the nucleus. High dose of irradiation prevented normal function, even in combination with an uninjured nucleus. The phenomenon of androgenesis was used as a source of evidence. (NAS 3; 1973, 1955)

I-B Genetic Effects

1-B-1 GENERAL

Surveys


Contents include a discussion of the limitations of 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; substructure 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 Monoriiella.


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 ploidy, relative sensitivity of chromosomes in different types of cells of the same species, changes in sensitivity of chromosomes in cells of the same species, and chemical and cytochemical studies. Many references to work on insects are included. Extensive bibliography, going back far beyond 1960.

Boulez, J. 1952 - 1985

Kihara, H. GENETICS OF BO AND RESULTS. Tottori 21-106

Barber is one of the best state over, linkage analysis and of the two (or more) is therefore a Simons (1961) Japanese. The genetics of bo development, linkage groups, physiological genetics, the sex development genetic were in discussed. Tausa's discovery of induced mutations is of great

Muller, H. J. SOME PRELIMINARY PHYSIC. 98 (Suppl. 1) (1966) 9-10

A review paper of wide scope. p. 65-70.

Muller, H. J. THE NATURE OF "RADIATION BIOLOGY", Vol. 1. H. Comprehensive review and one with Drosophila are cited to cover publications between 1967

Penfold, A. A. THE EFFS. Acad. Nauk SSSR Radiobiol. (1


The author presents a review of obtained. Different types of re- system. Spontaneous and induc- tion. Radiation damage in a complex problems of interpretation of the action of radiation chem radiation is discussed.

Tasaka, Y., ed. GENETICS (1967).

Very comprehensive work, parti work on radiation-induced muta

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 latter two insects is therefore of interest. Based on a bibliographical survey, Takabe's book "Genetics of Bombyx" (1956) mentions 944 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 Kihara's biochemical studies and Monod's developmental genetics were introduced. In practical applications, bacterial and induced mutations were discussed. Tatsuno'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: 20A, 1986)

Muller, H.J. SOME PRESENT PROBLEMS IN THE GENETIC EFFECTS OF RADIATION. J. cell. comp. Physiol. 59 (Suppl. 1) (1962) 3-79.


Comprehensive review and assessment of present day data, with extensive bibliography. Results obtained with Drosophila are cited throughout. The most recent work quoted dates from 1950; most references cover publications between 1945 and 1964.


The author presents a review of work 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 mechanisms as well as their synergistic effect with the direct action of radiation is discussed.


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 radiaction induced chromosome breakage. These criteria were measured on three types of Drosophila sex chromosomes. Correct interpretation of experiments using ring chromosomes are discussed. (NAY 29: 12068, 1963)

Rennie et al. 1982 - [1985]

227

The observed mutations are dominant in the sense that they produce a phenotypic effect in heterozygous condition. Their effect is homozygous condition is not predictable from results which could be gene changes that only give a detectable effect in heterozygous condition. The variance increases are more prominent 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 $1 \times 10^{-8}$ to $1 \times 10^{-9}$/hit is required to obtain a sufficient number of mutations to explain the variance increases.


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, early prophase, prometaphase, metaphase and anaphase, the earliest 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.)

(The abstract was published earlier in \textit{Radiation Res.} 2 (1954) 401).

Clark, A. M. \textbf{Genetic Effects of X-Rays in Relation to Dose-Rate in Drosophila}. \textit{Nature} 177 (1956) 787.

Using dose rates of 1000 r/min and 2000 r/min, it has been confirmed that, for a given dose, a greater amount of genetic damage is produced when the radiation is delivered at high intensity. With a total dose of 2000 r, the high dose rate gives an increase of up to 55% 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 arsenite in saline just prior to irradiation.


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

Glass and Paine 1950 - [1974]


Cells of the \textit{Drosophila} germ tracts were exposed to multiplets of 2000 r given on 6 d after emergence and at 14, 28 and 42 d thereafter. Eight days immediately following the first irradiation the percentage of sex-linked lethals mutations were, no radiation, 0.2; 2000 r, 5.6; 4000 r, 10.9; 8000 r, 13.5; and 8000 r, 18.3. 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, 2000 r at 28, and 2000 r at 42 d, giving an accumulated series of 2000, 4000, 6000 and 8000 r to each male. Sperm from these period showed mutation rates of 4.9, 5.2, 5.9 and 10.7% as contrasted with 2.6, 3.5, 3.5 and 3.5% 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 properties of the 42-day male clearing radiation damage from: 8000 r.

Hass, E. L., Dodgen, E. C. \textbf{Direct and Indirect Effects of the Translocation Rate in Drosophila Melanogaster.} The translocation rate in \textit{Drosophila} males tested included the DNA. \textit{O}_{a}^{2+}, \textit{N}_{2}, \textit{O}_{a}^{2+}, \textit{C}, \textit{O}_{a}^{2+}, \textit{C}, \textit{O}_{a}^{2+}, \textit{C} damage was greater at 34°C damage was induced in \textit{O}_{a}^{2+}, such factors which influence 18956, 1955).


Female \textit{Drosophila} were treated with individual of appropriate t cells may be considered to be more frequent after x-ray irradiation.

Heilbrunn 1954 - [1982].

Heilbrunn 1954 - [1982].

Heilbrunn and Abrahamson 1954.

Heilbrunn 1954 - [1982].

Hollander et al. 1952 - [1982].

Kaufmann and Wasser 1953.

Kooy, H.-G. \textbf{Untersuchungen II. STRUKTURVERÄNDERUNGEN LUNG VON EMERTONIN UNI II. Strukuralmodifikationen e Chemosporia 9, 5 (1950) 441-448.}

Embryo of \textit{Chromosporium shime} x-rays, and the resultant mold (deletion with open fragment, deductions on the possible size the experimental data collect 1957 - [1974].

Laven, H. \textbf{Genetics of CI 10th International Congress on Ottawa, Macmillan Ltd. 1958.}\n
Fundamental genetic research results in the \textit{Culex pingeri} complex sections and others. Severe and some spontaneous ones as in the \textit{Culex pingeri} complex.
GENETIC EFFECT OF LOW DOSES and UN International Conference on 5-G.

The variances increase at most

946
effect in heterozygous

II, 1952 - [1958]


The translocation rate in Drosophila virilis was used to measure the biological effect of x-radiation. Variables tested included the dosage rate, the temperature, and the gaseous environment (O<sub>2</sub>, CO<sub>2</sub>, CO, CO<sub>2</sub> + CO<sub>2</sub> + CO<sub>2</sub>). The dose rate 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 CO<sub>2</sub> + CO<sub>2</sub> than in air at 96% N<sub>2</sub> - 4% O<sub>2</sub>. The amount of O<sub>2</sub> and other factors which influence the oxidative metabolites of the cell modify the radiation damage. (BA 56: 1806, 1956)

947


Female Drosophila were treated with two different dosages of x-radiation, and the number of exceptional females was determined. The analysis of data indicates that all the exceptional flies may be considered to carry gross chromosomal rearrangements, and that gross rearrangements occur more frequently after x-radiation of oocytes than after x-radiation of oogonia. (NSA 8: 5474, 1954)

948

Herskovits 1954 - [1192]

Herskovits 1957 - [1195], [1196]

Herskovits and Abrahamson 1957 - [1195]

Herskovits 1958 - [1200]

Koller and Abrahamson 1958 - [1200]

Kaufmann and Waseeman 1957 - [1211]

949

Kehr, H.-G. UNTERSUCHUNGEN AM KARYOTYPES VON CHROMOMUS (I.E. TENDIPS) THEMMEL. II. STRUKTURVERÄNDERUNGEN AN DEN SPEICHELDRÜSCHEN-CHROMOSOMEN NACH BONTENBESTRAH- LUNG VON EMBRYONEN UND LARVEN. (Studies on the karyotype of Chromosomus (i.e. Tendips) themmeli. II. Structural modifcations of the salivary gland chromosomes after x-radiation of embryos and larvae). Chromosom 9, 5 (1958) 443-48. (l German)

Embryos of Chromosomus themmeli at 4 different stages and larvae up to 1.00 h old were irradiated with x-rays, and the resultant modifications are described. The most frequent types of changes are described (deletion of open fragment, and open inversion) show different distributions of inter-band spacing. Some modifications on the possible structure of the ambryotic salivary gland chromosomes may be made, based on the experimental data collected.

950

Kolwai 1957 - [1204]

951


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 insecticides and others. Several mutations have been found in Culex pipiens by means of x-rays. These and 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
the crossing type is determined by extra-chromosomal cytoplasmic factors. This intrinsic incompatibility mechanism seems to be a specific mechanism of evolution in Coleoptera. (end.)

Lewis, E.B. THEORY AND APPLICATION OF A NEW METHOD OF DETECTING CHROMOSOMAL REARRANGEMENTS IN DROSOPHILA MELANOGASTER. Amer. Nat. 28 (1964) 228-235.

A new method of position effect called the “transvection 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 (q) mutants have been found to be more effective than X-rays or Y-rays in producing re-arrangements in Drosophila, and estimates of the dose of fast neutrons at different stages during a nuclear detonation have been derived. (from auth. summary)


The relation between sex ratio and dose was used to investigate the effect of the 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. Irradiation of XY/Y males produces a slight shift in X'/Y' ratio from 0.850 with no irradiation to 0.805 with 4000 r, whereas irradiation of XY/O males produces a spectacular shift in ratio from 0.750 with no irradiation to 0.450 after 4000 r. These observations have been interpreted to indicate that (a) X-bearing sperm are much more sensitive than nullo-X, nullo-Y sperm, and slightly more sensitive than Y-bearing sperm; consequently (b) Y-bearing sperm are considerably more sensitive than nullo-X, nullo-Y sperm, and this difference may be directly attributable to the presence of the Y in the former; (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 FLY NUMBER IN FULL-EYED (REVERTED BAR) DROSOPHILA BY X-RAYS. (abstr.) Genetica 6 (1951) 563.

Larvae of an inbred full-eyed (reverted from bar) strain of Drosophila melanogaster, kept at 20°C, were treated with x-ray dosages ranging from 100 to 5000 c at the rate of 500 r per min. The corners of the eyes of the imagos which developed from the treated larvae were dissected off, mounted on slides, projected, and the facets counted. The x-rays produced a reduction in facet number. The rate of reduction was approximately 0.076 facets per c. The x-rays when applied before the larvae were 54 hours old produced no effect when the larvae were treated at 30 h old and 30 h old and 30 h old had no effect. Larvae treated at any time when they were from 60 to 90 h of age responded with essentially similar rates of reduction in facet number per c applied, with some evidence that the rate was less for the lower dosage used (1000 r). The x-rays prolonged larval development. The ratio of prolongation, approximately 0.613 h per c, appeared nearly constant for all x-ray applications within the age limits (60-90 h) used in this experiment with the qualification that the 5000 r treatment had a slightly diminished effect on the rate of prolongation.

* Luce et al. 1951 - (670)
* Luce et al. 1952 - (1206)


This study concerns the possible mutational adaptation due to incorporation in the population of mutational insensitive with lower mutability than the alleles originally present. A comparison was made between the rates of recessive lethals, and y, w, and 2 mutations induced by X-rays in males from Drosophila melanogaster stocks kept at normal background radiation versus those under constant y-irradiation (0 r/h). No differences in mutability were found between these two stocks, and hence there are no indications of mutational adaptation due to mutational insensitive. 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., Inst. Genetics. 1957, 7 p)
Oster, I. I. 

THE CONSEQUENCES OF X-BRADIATING MORPHOLOGICALLY DISSIMILAR CHROMOSOMES


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 spermatocytes 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, positionally demonstrable chromosome deficiencies, and semihaploid visible mutations. Heterozygous samples of spermatocytes containing either ring or rod-shaped sex chromosomes were treated in intermated females. X-irradiating rods yielded 44/1566 (i.e., lethals among treated chromosomes) for 1000 r, 65/1208 for 2000 r, 96/2368 for 4000 r, while the controls gave 41/1939. X-irradiating rings yielded 65/1602 for 1000 r, 51/1051 for 2000 r, 187/2091 for 4000 r, while the controls gave 14/4017. With high doses significantly more lethals were recovered from rings than from rods. Significantly more chromosome deficiencies were induced in the rod-X (16/1485) than in the ring-X (6/12300) by 4000 r, the control count for deficiencies being 1/41954 for rods and 6/52504 for rings. Nonlethal visible mutations were rare and induced in similar frequency in both stocks, these being more among controls. Thus treatment with high doses of x-rays results in a greater loss of those mutations 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 restoration of chromosome breaks.


956 Parker, D. R., McCord, J. A. 

A GENETIC ANALYSIS OF SOME REARRANGEMENTS INDUCED IN OOCYTES OF DROSOPHILA. Genetic 43 (1960) 370-86.

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

957 Ray-Chaudhuri, S. P., Pyne, C. K. 


Genetics punctifera males were subjected to y-rays from Radium. The frequency of bridges were shown to be independent of the intensity of radiation within the limits of the experiment (99 r given in 3 h or 23 h), counts on cells in metaphase I being made on material fixed 50 h after irradiation. The significance of these data with respect to the hypothesis put forward by Ray-Chaudhuri and Sarkar (1952) is discussed, (from abstr.)

958 Ray-Chaudhuri et al. 1957 - [1227]

959 Schmid, W. 

SIND DIE SICHTBAREN MUTATIONEN BEI DROSOPHILA MELANOGASTER FUR QUANTITATIVE STRAHLENGESCHICHTISCHE UNTERSUCHUNGEN GEEIGNET? (are the visible mutations in Drosophila melanogaster significant for quantitative radio genetic investigations?) Strahlentherapie 108 (1962) 78-96.

In German

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

960 Strangio, V. A. 


Sixty-eight sex-linked, recessive lethals were recovered following the irradiation of Drosophila males with 2100 r, 31, at the dose-rate of 200 r/min and 3 r at 100 r/min. Except for the rare extended phase lethal, the lethals were individual stage specific and also tended to group about sensitive stages in the developmental 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 rearrangement. An attempt to demonstrate a more obvious embryonic trend in the sensitivity pattern of the high dose-rate lethals, merging this intensity effect, was unsuccessful. Visible abnormalities associated with the lethals were tabulated. (auth.)


* Wallace 1956 - [1459]


Eighty-seven freshly emerged females were kept without food until only oocytes and very small oocytes remained in their ovaries. They were then fed and exposed to host Ephesia caterpillars immediately after these had been x-rayed with doses ranging from 40,000 r to 160,000 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 oviposit and feed on heavily irradiated hosts although they did so. It is evident that heavily irradiated host caterpillars exert no mutagenic effect on the parasite. (from auth.)

1-B-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-ray dose in Drosophila are reported; the influence of chronic irradiation with x-rays at low dosages 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 grasshoppers. General bibliography; 132 refs.

* Abashev and Pashchina 1960 - [883]
* Abrahams and Tallier 1956 - [1161]
* Abrahams and Henrikson 1957 - [1158]

* Alexander, M. L. X-RAY SOME OF DROSOPHILA: A
The mutation rates were: 1) were employed (1) to limit mutations, (2) to assure as (5), 76 x 10^-4 mutations x-rays on the 3 loci of the 1. The induced mutations were tested in the homozygous, (abstr.) (For critical discussion, of

* Alexander 1954 - [1169]
* Alexander 1956 - [1161]
* Alexander 1967 - [1162]
* Alexander 1968 - [1165]
* Alexander 1969 - [1184]
* Amano 1964 - [1134]
* Amano et al. 1951 - [1187]

Atwood, K.C., Boye, R. EXPRESSION OF DOMINANT
The frequencies of x-ray induction of mutations increased by subsequent lethal effect induced at m, the induced mutations of the lethals are induced at m. Phenotypic dependence that lethally caused by of complete, Chromosome bro, in metaphase than in prophase

* Baker and Sgonnati 1950
* Baker and Edington 1955
* Baker and Halle 1960 - [1054]

Baker, W.K., Halle, E.S. NEUTRONS FROM CYCLOTRON.
Data are presented on the: from nuclear detonations a click that the frequency + measurement of fast neutrons (NSA 8: 3652, 1964)

* Batesman and Sinclair 1950
* Batesman 1956 - [1173]

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 chimer" mutations, (3) to assure samples from treated spermatogonia by use of early larval stages. An average rate of \(5 \times 10^{-6}\) mutations per \(r\) per locus is reported in some 40,000 flies in testing the effects of \(8000\) r of x-rays on the 8 loci of the \(Cy\) group of mutations. The rates per locus varied from 0.5 to \(8 \times 10^{-6}\) 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.)

* (For critical discussion, cf. *Ives* 1984 - [1192])

**

Alexander 1954 - [1165]

* Alexander 1956 - [1167]

* Alexander 1957 - [1162]

* Alexander 1958 - [1168], [1163]

* Alexoas 1958 - [1134]

* Mann 1964 - [1134]

* Armstrong et al. 1961 - [377]

Atwood, E. C., Boncel, R. C. von, Whiting, A. R. *AN INFLUENCE OF PICKLY ON THE TIME OF EXPRESSION OF DOMINANT LETHAL MUTATIONS IN DROSOPHILA.* *Genetics* *41* (1956) 264-279.

The frequencies of x-ray-induced dominant and recessive lethal mutations in *Drosophila* are unchanged by subsequent fertilization with untreated 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 metaphase 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. (summarized)

* Baker and Soutarshi 1958 - [1369]

* Baker and Edington 1958 - [1360]

* Baker and Hale 1958 - [1362]


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*. (NIA B-2552, 1964)

* Bateman and Sinclair 1956 - [379]

* Bateman 1955 - [312], [379]

* Bateman 1960 - [1172]


Bertram and Höhne 1958 - [1175]

Bertram, E. AND K. MÖNTGER. 1959 - [1176]


Spermatozoa in D. melanogaster may be irradiated in males or 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. Lind is investigating the nature of these processes which show the mentioned differences in rates. When irradiating males spermatozoa containing the "Mahler-S" X-chromosome, bred 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 genotypes of the females.
which caused changes that alli
roots involved is attempted. It
last then at the end of the 2nd

GASTER (The lethal-bleeding
1/4 (1957) 348-52. (In German)
the second chromosome. The
thickness, the protein and not
ring the hemolymph is last.
animal dies. If carefully re
offspring are 86% lethal, the
apparent abnormality.

A study is reported on problems concerning x-ray induced mutations in the second chromosome of Drosophila. The frequency of such viability mutations are considered, and the comparisons made 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 mutants, partitioning of the variance into components, discussion on survival rates, larval competition tests, and considerations concerning the study and the structure of irradiated populations.


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 spermatozoa 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 spermatozoa when being within the seminal receptacles of the females as compared with their state within the males. (auth. summary)


In Drosophila, unfertilized eggs develop normally to become haploid males; fertilized eggs become diploid females. Females which had stored eggs in the first mitotic 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. These 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. A summary of relative number of dominant lethals can be obtained in this case. In the unfertilized eggs, fertilized eggs did not differentiate as in the first mitotic 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 mitotic prophase.

(Abstr. paper presented at the 1956 meetings of the Genetics Society of America, East Lansing, Michigan, 6-8 Sep., 1955)
In Habrobracon and Drosophila, induction of the breakage-fusion-bridge cycle with consequent gene imbalance has been considered as the primary source of dominant lethality. Habrobracon eggs irradiated in the first mitotic metaphase show terminal deletions that result in bridges in the second mitotic anaphase and bridge-breakage during cleavage. Since the breakage-fusion-bridge cycle does not appear to be established in eggs irradiated in the first mitotic prophase, the question arises as to the cause of dominant lethality in these eggs. Examination of dead Habrobracon and Drosophila embryos from irradiated eggs (unfertilized, or fertilized subsequent to X-irradiation at about the 50% lethal dose (15,000 r) shows that approximately 60% have been blocked in development at the sixth or seventh cleavage and the nuclei are Pachycenous negative. Thus it appears that dominant lethality in these eggs is associated with interruption of deoxyribonucleic acid synthesis. Approximately 96% of dead Drosophila embryos from irradiated sperm (at 50% lethality, 2000 r) die under similar circumstances. These resemble the specific lethality in Habrobracon 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 compare a variety of asynaptic types. Since all eggs from Habrobracon triploids and more 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 dominant lethals associated with the radiation effect on deoxyribonucleic acid synthesis in Habrobracon are clearly not the result of chromosomal deficiencies.


In Habrobracon 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 as to 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 inviable progeny of triploids or translocation heterozygotes. It has been found that asynaptic embryos from Habrobracon and Drosophila females from irradiated males fail to show the majority of radiation-induced dominant lethals. Comparative evidence was obtained from examination of death embryos from heterozygotes of two different Drosophila translocations and four differently induced Habrobracon translocations; it was found in each instance that death is expressed after blastoderm formation. Since asynaptance in neither Drosophila nor Habrobracon brings about death during early development that is most characteristic of radiation-induced lethality, it appears that radiation induction in large measure is a type of dominant lethality that is not attributable to the loss of chromosomes or chromosome parts resulting from chromosomal breakage.


In the parasitic wasp Habrobracon, unfertilized eggs become normal haploid males; fertilized eggs, diploid females. Three types of dominant lethal mutations have been identified in Habrobracon. 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 by 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 Habrobracon eggs irradiated in the first mitotic 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 late in embryogenesis in the diploid and in the haploid, but always before hatching. Type III, with Type I, is characteristic of Habrobracon eggs irradiated in the first mitotic prophase. In Habrobracon, five translocations, when hemizygous, produced asynaptic embryos that all died under the same circumstances that characterize Type II dominant lethality. Type III dominant lethals are exactly uninked by radiation-induced dominant lethals of Type I and Type III has by aneuploids from triploids of radiation. Even Drosophila the associated meiotic death

Heinrich R. C. von, Lethal LETHALITY IN HABROBRACON

This kind of dominant - Habrobracon, a similar is specified. In the paper, a lethality induced by radiated Drosophila are not mimic

Boswell, R.C. von, Lethal LETHALITY IN HABROBRACON

In the wasp Habrobracon, at least three types (I, II, III) are typically distinguishable. It is possible to show that imbalance and that ratio the most common type of rate. The slowing of the meiotic organizer but in that any other action of I. lethality. (cont.)

Brandt and Holme 1955 -

Brandt and Holme 1953 -

Bussari-Traverso, A.A. of the 5th International C., Chiang, A., eds.

It was shown that, under intact rate proved an advanced implications of these one

Bussari-Traverso and Scotti

Caspari, S. B. AN X-RAY MORMONILLA, Radiat.

A study of mutants of and m of 1000 to 5000 r: wild-tying and analyzing the micromutations. F. G. mosaic.

Clark, A. M. Rubin, M. MATURE STEMS OF HABR.

Males from stock No. 1 were 1160 to 5850 rep. At a d of males with 7000 r at
were 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 genetically 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 Habrobracon
by aneuploids from triploid females or translocation heterozygotes. Type I is specifically induced by
radiation. Even Drosophila syngens deprived of genetic means of the X and Y chromosomes and lacking
the associated male tissues develop further under Type I dominant lethal conditions.

Borstel, R.C. von, Rekenmeyer, M.L. RADIATION-INDUCED AND GENETICALLY CONTROLLED DOMINANT
LETHALITY IN HABROBRACON AND DROSOPHILA. Genetics 44 (1959) 1059-74.

Three kinds of 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 controlled loss of chromosomes or loss of chromosome
core parts.

Borstel 1960 - [1059]

Brand and Höhne 1959 - [1379]

Brand and Höhne 1958 - [815], [816]

Bussani-Tavano, A. A. ON THE ROLE OF MUTATION RATE IN EVOLUTION. p. 350-60 in Proceedings
of the 9th International Congress on Genetics, Bellagio, Italy 1957*, Suppl. to Cytologia. G. Montalenti,

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.

Bussani-Tavano and Scomirski 1958 - [1427]

Campari, S. B. AN X-RAY STEM-DOSE-ACTION CURVE FOR MUTATIONS AT A SINGLE LOCUS IN
MARMONONIUM. Radiation Res. 8, 3 (1958) 272-83.

A study of mutants and mutation rates for a single locus, R, in Marmosita was made by x-irradiating (at doses
of 1000 to 5000 r) wild-type males, mating them to females of a double recessive peach stock, and counting
and analyzing the mutants appearing among the F1. Analyses were made for four kinds of mutations: S, C, recessive lethals and recessive sterility. (From abstract summary)

Clark, A. M., Rubin, M. A., Fluke, D. ALPHA-PARTICLE-INDUCED DOMINANT LETHAL IN THE
MATURE SPERM OF HABROBRACON. (abstr.) Radiation Res. 7 (1958) 461.

Males from stock No. 1 were irradiated with 80 MeV protons from a cyclotron at doses ranging from
1150 to 68,500 rep. At a dose of 5700 rep, 98% of the sperm carried at least one dominant lethal. X-irradiation
of males with 7500 r showed that 98% of the sperm carried at least one dominant lethal. These

287
x-ray data are comparable to those reported by Haldane (1946). Thus, for equal exposures of energy, the same number of dominant lethals are obtained for α-particles and for x-rays.


Selection for abdominal chiasma has been carried out in an inbred line of D. melanogaster, both with and without irradiation by 1000 x-rays of each generation. The response in the control moths to 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 chiasma 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.

(Author's summary)

Colombo, G. PRIME RICERCHE SUI LETALI DOMINANTI INDOTTI DAI RAGGI X SU MASCHI DI LOCUSTA MIGRATORIA MIGRATORIOIDES R. AND F. (ORTHOPTERA) (Initial research on the dominant lethals induced with x-rays on the males of Locusta migratoria migratorioides R. and F. Orthoptera), Riv. Sci. 35, 16 (1939) 993-41. (In Italian)

Males of L. migratorioides at 4th instar, just after the larva moult and a month after the last moult were irradiated with x-rays from 50 to 1600 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 damage 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 frequency of dominant lethals increased when more mature germ cells are irradiated. This result is explained by cell selection against germ cells irradiated in presomatic and metiotic 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 presomatic stages.

(Author's summary)

Cunha et al. 1958. (463, 1440)

Cunha et al. 1959. (4641)


Fast electrons (> 3 MeV) were found more effective in inducing recessive sex-linked lethal mutations in D. melanogaster than equal x-ray doses in experiments of Yurchenko-Benkovsky (1944) and others. This difference, however, is not statistically significant. Spontaneous mutations of this kind did not occur.

BA 26: 17130. 1952


It has been found that the frequency of recessive lethals induced by x-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, or two, or all of the following two-hit genetic effects: (1) two independent semilethals, each together act as one, recessive lethal, (2) gross deficiencies, and (3) "position-effect" lethals, which are dependent on gross chromosome aberrations for their expression. (From abst.)


Edington 1956. (B18)

Glenobity, Ya. L., Abele-GENETICS UPON THE RATE OF Ti (1940) 8 p. (Revised): Irradiation of Drosophila reproductive lethals. Fractional in the mutagenic effect. The lethality corresponds to the results lethals have a mutagenic for fast neutrons spermatic; absence of a threshold. The
Melanogaster, both with and without control stocks in 17 generations, were compared with wild populations by Maubot and co-workers. New variances in abdominal color were found in our results. The variance of these results is discussed.

EGGI X SU MASCHI DI SULLA RICERCA SOVRAZENALE SUL DOMINANTE B R F CHITONOPSIS).

Each after the last results were re-irradiated single flies were used in spermatozoa, spermatids, spermatogonia of present and, to explain the frequency of dominant males in cell selection, we had already tested the dominant males in cell selection against germ

BEZESKI GROSCHLEICHTS-EKONEN EPSO'S MEY-SA-13 ELECTRON OF 9 MEV -

Three lethal mutations in Drosophila (1941) and others. This of this kind did not occur.

RECESSIVE GROSCHLEICHTS- 

Drosophila melanogaster, inferring. This non-linear increase the following two-true genetic lethal, (2) gross deficiencies, preparations for their expression.

American States, Corporation.

Bilston 1858 - [1877]

Endsman 1960 - [1867]


An isogenic Drosophila stock was irradiated with an x-ray dose of 3000 r. 97.7% of the irradiated chromosomes were lost 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 effects of the mutations in the homzygous as well as the heterozygous flies. The lethal part of the subvital mutations only was left for the viability test. Of the tested experimental stocks, 76% were affected in their viability. Among these the subvital mutations occurred about 3.0 times more frequently than the lethals. Among the subvital mutations, those less affected occurred more frequently. In about 1/3 of the mutations the effect was partially or completely dominant.

Fritz-Niggli 1956 - [1952]

Gorodinovich, L.L., Abalavena, E.A., Basimov B.A. VISHUMEN MAH DOSH KOMPARIIZUZU RADISHI.

HURGERA RAZOBO DROSHILA 21 (1960).

1. Observed the effect of x-rays in Drosophila melanogaster. Fractionated x-irradiation of the flies at 20 r per day for 5 r. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

2. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

3. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

4. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

5. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

6. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

7. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

8. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

9. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.

10. Observed the effect of the x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female. The effect of x-rays on the number of eggs per female.
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 certain criteria, do not differ from spontaneous mutations. D. melanogaster females homozygous for one or the other of the crossed pseudohybrids, f² and f, both known to back-mutate spontaneously, were irradiated. A comparison of the induced and spontaneous rates of reversals shows that 9000 x-rays increased f² reversals 7-fold, whereas equivalent γ-irradiation increased somewhat more than tripled the reversal frequency. Back mutation of f² were significantly increased, those of f apparently not. The back mutations are not associated with detectable chromosome alterations.


(For details see ref. 995)


L’étude des mutations létales récessives, liées au sexe chez D. melanogaster montre que le pourcentage des mutations spontanées apparaissent dans la souche utilisée s’élève à 0.001%, des doses de rayons X aussi faibles que 40 γ ou 20 y peuvent augmenter de façon appréciable le taux de mutabilité (respectivement 3.3079% et 0.1919%). Les mêmes quantités totales de rayonnement, fractionnées en doses partielles de 1 γ sont encore plus 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 0.3079%). Il semble que le recouvrement des intermittences entre les expériences partielles conduise à une augmentation progressive du taux des mutations, qui tend vers celui obtenu après irradiation continue. (auth.)


The translocation induced by chromosome irradiation is probably a reciprocal interchange involving the W chromosome and a Zebra-lemon 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 locos-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-determining factor occupies a certain restricted region of the chromosome, while the other regions have a lethal effect for the male which carries it. (auth.)

998 Heidrich, G. X-RAY INDUCED RECESSIVE LETHALS IN HABROBACON. Genetics 57 (1963) 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 then allowed and then copulated to haploid males. F₁ virgins which developed only from eggs x-rayed in 1st metaphase were then tested by allowing each to lay eggs. These were counted and later examined for hatchability. Control hatchability for comparable F₁ was well above 99%, for no female will it drop to 99%. 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 t and 16.2% for 1000 t. Comparable data for recessive lethals induced in sperm also been shown to be applicable.

(abstract of paper presented at)

999 Heidrich, G. A COMPARISON OF MEiotic METAPHASE EGGs Methods have been developed for scoring mutations in sperms and eggs the dominant lethal assay and the 30% at about 1000 t. phase eggs were found to be a dominant and recessive lethal chromosome.

1000 Heidrich, H., Fedor, H. D. BILDUNG DER MEHLAUGE I. the formation of the floor m.

The cells of the rudimentary 1st differential stage of cell division in the form of dark s appearance of such mutant eg. somewhat between the line.

1001 Herskowitz, I. Heterozygous mutations produc. the normal tissue and kill the apparatus, neither are detected, partly via different typ.

1002 Herskowitz, I., Raush, M. MUTATIONS IN DROSOPHILA Heterozygous mutations produce nutritional stress and kill the apparatus; no effects are detected, partly via different types.

1003 Herskowitz, I., Raush, M. - [1192]

1004 Herskowitz, I. Harber, H. - [1192]

1005 Herskowitz, I., Raush, M. - [1192]

1006 Herskowitz, I., Raush, M. - [1192]

1007 Herskowitz, I., Raush, M. - [1192]

1008 Ives, P. H. RADIATION IND. 361-6.

A comparison is made of radio considering principally the toxic effects of x-rays using only autoradiograph of the few somatic loci so far rate per cell locus appears to be.


The fast neutrons of a sonic linked lethal and a somatic lethal within linked lethal chromosomes.
which, according to current mutations in X-which, according to current research, is the case. They are not associated with the dominant or recessive lethals induced in sperm. The above method has also been shown to be applicable to the much more resistant prophase stage.

(Abtract of paper presented at the 1938 meeting of the Genetics Society of America.)

Heldenaethel, G. A COMPARISON OF X-RAY INDUCED DOMINANT AND RECESSIVE LETHALS IN FIRST MEIOTIC METAPHASE EGGS AND IN SPERM OF DROSOPHILA. (abstr.) Genetics 33, 7 (1948) 668.

Methods have been developed for estimating X-ray induced dominant and recessive lethals. Natural pedigrees have permitted study of rates for the entire chromosome complement. For the metaphase eggs, the dominant lethal curve is a simple exponential function with the 50% lethal point at about 375 r and the 90% at about 1,000 r. For recessive lethals, the dominant lethal curve for the sperm is markedly different. The metaphase eggs are found to be more radiosensitive than the sperm. The effect of dose rate on induction of dominant and recessive lethal factors is discussed. (from abstr.)


The cells of the ordinary hind wings of Ephesia pass through S = 4, as previously supposed - differential steps of cell division in the course of the stages of the pupal and prepupal period. A somatic mutation in the form of dark scales is often observed as 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 moult and before the onset of the prepupal mitotic period is discussed.

Hartsoeker and Abrahamson 1955 - [1109]

Hentschel 1956 - [1109]

Hentschel and Schäfer 1957 - [1109]


Hypothesized mutations produced by X-rays delay pupation in about 9% of larvae of Drosophila and cause approximately 9% of larvae to be affected in some way. The effects are less, though appreciable, when there is no X-ray irradiation, and effects are detectable after eggs are irradiated. Irradiated sperm and oocytes cause complete, usually of different types of mutation, in approximately equal amounts. (auth.)

Hentschel et al. 1959 - [1109]

Hohne and Schubert 1964 - [856]

Hohne et al. 1959 - [1109]

Hohne et al. 1959 - [1109]


A comparison is made of radiation-induced mutation rates in Drosophila melanogaster and mice by considering principally the data of Russell (Genet. Q. 14 (1953) 107-109). The author is also interested in the non-randomness of the mutation rates of the few autosomal loci so far studied. It is concluded that the present radiation-induced mutation rates per cell per locus appear 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 mutant-cured 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 lethals. (auth. summary)


Spermatogonia from 24-old inbred Oregon-R males were tested by Ivers after exposure to Co60 γ in doses ranging from 500 r to 12500 r in intervals of 700 r to 5500 r. For each of 7 doses a minimum of 1000 X-chromosomes was tested and a minimum of 128 lethal chromosomes was observed. Plotted directly the data fit a straight line with a slope of 1.38% lethal chromosomes per 1000 r. Individual mutational events probably occurred at a greater than linear rate of increase with increase in dose. Tests with 436 lethals chromosomes from 300 r showed only 2 instances of separable lethal genes and 23 cases with reduced crossing-over of 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 23 analyzed cases of reduced crossing-over were inversions. (term above.)

Ivers, P.T. THE RELATIONSHIP BETWEEN RADIATION DOSE AND DOMINANT VISIBLE MUTATION RATE IN DROSOPHILA MEelanOGaster. Genetics 44 (1959) 967-76.

Mature sperm of Drosophila melanogaster were subjected to γ-radiation from a Co60-source. Tests were made of the frequency of easily seen visible mutations, chiefly autosomal 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. (term above.)


Three series of X-chromosome lethal mutations, from the mutator bi, from 300 r and from 12.5 r 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 mutation genes are genetically more specific, involving radiation 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 such strain by a given radiation treatment should be generally alike. (term above.)


Data are presented from a study of the sex-linked mutation rate in mature sperm of Drosophila melanogaster at seven dosage levels of Co60 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 dosage range, with an average increase of 5% lethal mutations per kr. (term above.)

Kifer, E. VITALITÄTS-MUTATIONEN, AUSGELÖST DURCH RONTGENSTRAHLEN BEI DROSOPHILA MEANALOGASTER (Studie an Mutationen auffälligkeits, induziert durch x-rays in Drosophila melanogaster). Z. indukt. Abstamm.-Vererbungs. 94 (1962) 503-55. (In German)

A comparison of x-ray-induced mutations in the x- and in the second-chromosome in sperm male was made. It was found that in both types of chromosomes slightly higher rates of recessive lethals were induced than of strong dcl. mutants.

* Kaplan and Lyon 1953 - (1954)
* Kayhart 1954 - (1955)
* Kayhart 1956 - (1957)

KING, R.C. REDUCTION IN X-RADIATION OF FEMALE. Sex-linked recessive lethals w melanoagaster irradiated with 4 that of males treated in an ide which reaches a value only 69 frequency is taken away from the class of chromosome ab reduced for the first four 4 days. After a week has passed the 4 by females contain 69% as The rise in productivity of it laid at this time were 26-cell same fashion as is polypliod (6)

KING 1953 - (69)

KING, R.C. MUTATION IN NEUTRON-ACCTIVATED PRICE. The x-ray induced recessive is not X chromosomes are modif activated, phosphorus-bakelite recessive lethal mutations. This to them by the two classes of polynucleotide and calculated a; %41 labelled Drosophila male (See also BM-1949, Benjamin)

KING, R.C., Wood, E.M. SI MALE AND FEMALE DROSPAN. The recessive lethal mutation highest dosage tested (4, 5 r x 10 to 8.5 x 105 m3/cm²). The oogenesis 29% the male rate, 1 rate for sperm. To explain the it is assumed that either the the that a large fraction of the per combination. On the basis of found to be 0.8 times as effect sperm and 1.8 times as effect is not related to the higher me basis of the action of this dial nitrogen content for Drosophila

KING, R.C., Wood, E.M. SI FEMALE DROSOPHILA MEANALOGASTER. Germinal tissue of D. melanogaster primarily responsible for the bi as effective in producing sex- does the lethal mutation mutation rate determined in viable Eggs laid ≤ 8 and ≤ 8-10 d to original rate is only 79%, the 2 female germ line may be due late stages of germline in as male gonad. In the female ge early meiotic stages that from