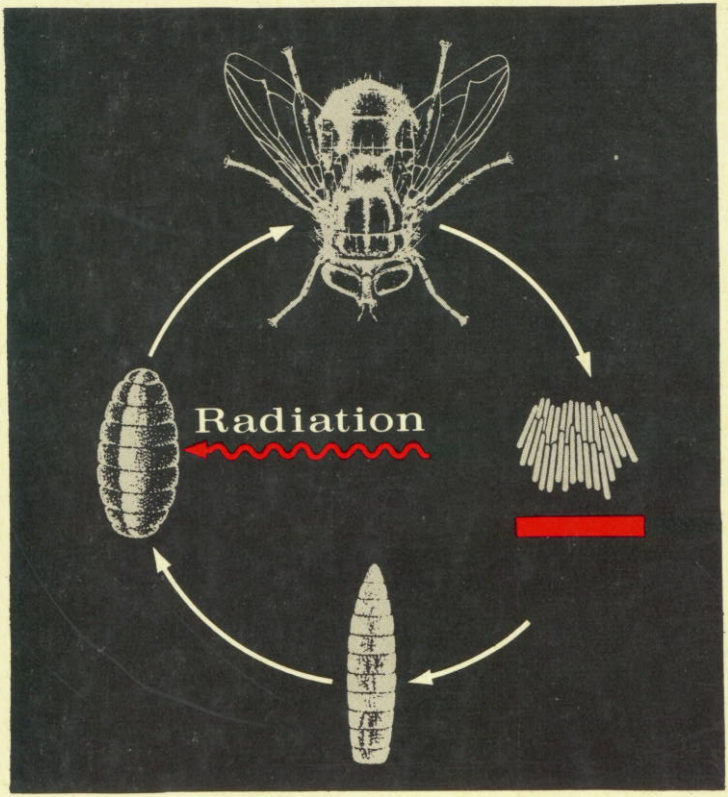
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Radioisotopes and Ionizing Radiations in Entomology

Vol.IV (1966-1967)

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1969

RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY

Vol. IV

(1966-1967)

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FOREWORD

The present bibliography on Radioisotopes and Ionizing Radiations in Entomology represents the fourth and probably final volume of a series which covers the years 1950 to 1967:

1950-1960	11 years	1577 references
1961-1963	3 years	1585 references
1964-1965	2 years	1074 references
1966-1967	2 years	1800 references

The first three of these volumes were published as Bibliographical Series Nos 9, 15 and 24, respectively. The figures for references indicate the dramatic and continuing increase in published work in this field and explain why it is unlikely that the IAEA will continue this documentation service.

The bibliography is again fully annotated, and abstracts have been included wherever possible. The bibliography is organized in such a way as to permit several different approaches to the individual references. In the first place, the references are grouped together according to a broad classification scheme of different areas of work. Within each section or sub-section, they are listed in alphabetical order of authors. There is a detailed Subject Index which identifies the radioisotopes or radiations used in the particular study cited; a taxonomic index for insects and related arthropods; and special additional tables to identify insecticides studied with radiotracers, both by their chemical and by their proprietary names, with an indication of the system (insect, plant, etc.) used. Finally, there is an Author Index showing each author's affiliation (with date).

The documentation will be of practical use to the specialist requiring a rapid survey of relevant publications in related disciplines, to someone in search of detailed documentation on a particular aspect of the field, and to the scientist in developing countries whose access to the world literature might be somewhat limited.

The bibliography was compiled by Mrs. M. BINGGELI of the Agency's Division of Scientific and Technical Information.

Readers are invited to address their suggestions and other correspondence regarding the "Bibliographical Series" to: The Director, Division of Scientific and Technical Information, International Atomic Energy Agency, Kärntner Ring 11, P.O. Box 590, A-1011 Vienna, Austria.

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INTRODUCTION

COMPILATION OF BIBLIOGRAPHY AND GUIDE FOR ITS USE

SOURCES

The bibliography was compiled from the open literature.[1] A first routine search involved scanning selected secondary sources:

(a) Abstracting journals

Biological Abstracts (BA)
Bulletin Bibliographique:
Isotopes. Rayonnements. Agriculture.[2] (BB)
Chemical Abstracts (CA)
Dissertation Abstracts (DA)
Nuclear Science Abstracts (NSA)
Review of Applied Entomology
series A: Agriculture (RAE-A)
series B: Medicine (RAE-B)

(b) Title listings

Atomindex[3] (STI/Doc/12, fortnightly) (LOR)
Bibliography of Agriculture (BAg)
Biological and Agricultural Index (AI)
Bulletin Signalétique Hebdomadaire (BS)
- Périodique de Chimie[4]
Current Contents
Chemical, Pharmaco-Medical &
Life Sciences[4] (CC)
Pesticide Documentation Bulletin (PDB)

Subsequently, primary sources were scanned, abstracts being prepared where necessary.[5] Otherwise, sources of abstracts are indicated. References cited in original papers were followed up, this method of documentation search proving particularly productive. Numerous books, conference proceedings, bibliographies, and reports were also scanned, including such review series as A. Rev. Ent. 11 (1966) and 12 (1967) (Smith, R. F.,

---

[1] With the addition of some title citations for reports.

[2] Includes keywords but no abstracts.

[3] List of references to current literature, including numerous reports, received routinely by the International Atomic Energy Agency.

[4] Lists contents of a variety of journals.

[5] Either because no abstract was available or because the existing abstract proved not sufficiently informative on the technical aspects stressed by the bibliography.

Mittler, T.E., Eds), Adv. Insect Physiol. 4 (1967) (Beament, J.W.L., Treherne, J.E., Wigglesworth, V.B., Eds), Residue Rev. (Gunther, F.A., Ed.), also periodic bibliographies in Anz. Schädlingsk., Drosoph. Inf. Serv., Fd Irrad., Entomophaga, Mosquito News, Pesticide Prog., and others.

Papers presented at meetings and published as abstracts only have been cited, usually in toto, since they often give enough information for the interested reader to decide whether he wishes to write to the author; in such cases, he can find the author's address in the Affiliation Index.

Among the selected journals scanned routinely are:

Am. J. trop. Med. Hyg.
Ann. appl. Biol.
Ann. ent. Soc. Am.
Anz. Schädlingsk.
Appl. Ent. Zool.
Archs Biochem. Biophys.
Atompraxis
Aust. J. biol. Sci.
Biochem. J.
Biochim. biophys. Acta
Biol. Zbl.
Bull. ent. Soc. Am.
Bull. ent. Res.
Can. J. Biochem.
Chromosoma
C.r. hebd. Scéanc. Acad. Sci. D
Dokl. Akad. Nauk SSSR – Biological Section
Drosoph. Inf. Serv.
Ecology
Entomologia exp. appl.
Ent. Rev. (AEC-tr-Russian)
Experientia
Expl Cell Res.
Fd Irrad.
Genetics
Genetika
Hereditas
Insectes soc.
Int. J. appl. Radiat. Isotopes
Int. J. Radiat. Biol.
Isotopenpraxis
Jap. J. appl. Ent. Zool. (Nihon Oyo Dobutsu Konchugaku Zasshi)
Jap. J. Genet. (Idengaku Zasshi)
J. agric. Fd Chem.
J. Ass. off. analyt. Chem.
J. biol. Chem.
J. Cell Biol.
J. econ. Ent.
J. exp. Biol.
J. Hered.
J. Insect Physiol.
J. invertebrate Path.
J. med. Ent.
J. molec. Biol.
J. Sci. Fd Agric.
Kernenergie
Life Sci.
Mosquito News
Mutation Res.
Nature, Lond.
Naturwissenschaften
Nucleonics
Pesticide Prog.
Proc. ent. Soc. Ont.
Radiat. Res.
Radiobiologiya (Radiobiology, AEC-tr-)
Science, N.Y.
Z. indukt. Abstamm.-u. VerbLehre

The omission of an abstract for a given reference may be due to one of the following reasons:

(1) the reference had originally been obtained from a title listing or from a citation in another publication, and the compiler had not been able to obtain the original article;

(2) the original article had appeared in interim form intended only for limited circulation, and permission could not be obtained for quoting details; or

(3) the original articles were descriptions of projects or progress reports which would largely be outdated by the time the bibliography appears in print, much of the results having been published in the literature by then.

Such references have, nevertheless, been included as title citations and appropriately indexed since some readers might wish to follow them up by establishing direct contact with the scientists concerned; again the addresses of the authors can be obtained from the Author Index.

Reports

Numerous reports have been abstracted, and may be considered valuable as indicative of trends in a particular field or institution. The user is thus enabled to contact a particular scientist, even if no conventional publication is (yet) available.

REFERENCES

References are arranged by subject matter as set out in the table of Contents. Articles reviewing the particular subject or of a general or introductory nature are placed at the beginning of a section. Such reviews are more specific than those reported in the Addendum (3.2. Bibliographies and General Surveys), where broad fields are surveyed.

Where new data (e.g. abstracts) have been obtained on references included in Vols I - III, their original number, preceded by the volume number, are also indicated; an abstract may thus be added to a reference originally cited by title only, e.g. reference 1146 had been cited as reference 1038, without abstract, in Vol. III. This fact is indicated by 1146 = III/1038.

Cross-References

These are cited at the end of each section, giving the title (in English only), first author, year of publication, and the reference number. Despite the very detailed Subject Index, cross-referencing has been used extensively.

ADDENDUM

Techniques

Some selected papers representative of particular techniques (e.g. autoradiography, neutron activation analysis, etc.) have been grouped together.

TABLES

Three tables have been compiled.

Table 1. Systematic Listing of Insects and Related Arthropods

The insects and related arthropods cited in the bibliography are grouped together systematically by order, family, genus, and common name.[6] Their place in this table is also indicated in the Subject Index where the systematic code appears next to the scientific name.[7]

Table 2. Radiotracer Studies on Insecticides

This table gives a digest of radioisotope tracer studies on insecticides. Chemical names and other designations are indicated throughout. The parti-

[6] Largely based on the scientific and common names listed in Bull. ent. Soc. Am. 11, 4 (1965).

[7] Traceable via the common name, if the scientific name is not known.

cular radioisotope used in an analysis or synthesis as well as the animal, plant or particular substrate used in metabolic and residue studies are given. The insecticides have been grouped in certain broad categories, also used in the two Insecticide Indexes.

Table 3. Some Insect and Related Arthropod Pests: Guide to Colonization and Mass Rearing

Various people had suggested to the compiler that, in view of the increasing importance of the sterile-male technique for insect control, it would be useful to list the laboratories with experience in the colonization and mass rearing of insects. Although it was not possible to carry out the survey that would be needed in order to produce a comprehensive list, a recently published book does, in fact, provide much useful information. The book is entitled "Insect Colonization and Mass Production" and is noted in the bibliography as reference APX. 11 in the Appendix. No attempt has been made to collect information beyond the period or areas covered there, but a table has been compiled as a g u i d e to the rearing of various types of insect and related arthropod pests, with indications of their common and scientific names, taxonomic code, and some specialists in the particular field with affiliations.

INDEXES

Insecticide Indexes

To facilitate checking of an insecticide, e.g. where a synonym has been used, the following two indexes have been compiled:

(i) Common and Manufacturers' Names Index

(ii) Letter and Number Index

to be used in conjunction with Table 2.

Author Index

1. A Corporate Author Index has been compiled.
2. Personal Author and Affiliation Index.

As far as possible, up-to-date affiliations have been indicated for each author. Sole or first authors, in cases of joint authorship, have been indicated by underlining the pertinent reference number.

Subject Index

A detailed Subject Index is provided. The radioisotopes or radiations used are indicated for each reference. The following convention has been adopted concerning the position in which they are cited with regard to a particular study: When the radioisotopes or radiations represent the cause they precede the phenomenon reported; when used as a tool for analysing existing conditions they follow the phenomenon studied. Irradiation, when combined with other modifying treatments (gaseous environment or temperature at irradiation, etc.) is quoted as radiation/treatment. When a comparison

between radiation and other treatments (e.g. chemosterilant) is made, a comma is used to indicate this, e.g. x, tepa: housefly. Further illustrations are given on page 687. Life stages or tissues relevant to a particular study are indicated, in brackets, whenever possible. A considerable amount of information may thus be obtained at a glance.

GLOSSARY*

α	alpha radiation
(a)	adult
AET	aminoethylisothiuronium bromide hydrobromide
ATP	adenosine triphosphate
ATPase	adenosine triphosphate phosphohydrolase
att	attached
β	beta radiation
(c)	cocoon
CNS	central nervous system
(d)	diapause
(dpp)	diapausing pupa
(Dp)	Dauerpupa
DNA	deoxyribonucleic acid
DNase	deoxyribonuclease
dopa	β-(3,4-dihydroxyphenyl)-L-alanine
DPN^+	diphosphopyridine nucleotide
e	electrons
(e)	egg
EDTA	ethylenediamine tetraacetate
EM	electron microscop(y) (ical findings)
(emb)	embryo
e.m.	electromagnetic fields
e.s.	electrostatic fields
(h)	hypopial stage (mites)
ir	infrared
i.v.	intravenous
(ℓ)	larva
(ℓ5)	5th larval instar
LD	lethal dose
(m)	metamorphosis
NA	nucleic acid(s)
n	neutrons
(n)	nymph
n_f	fast neutrons [when energy is specified suffix is dropped]
n_s	slow neutrons
$NADPH_2$	nicotinamide adenine dinucleotide phosphate
n.d.	non-dated
OP	organophosph(orus) (ate) [underlined to avoid confusion with elements]
P_i	inorganic phosphorus
p	protons

* Excluding chemical elements.

(p)	pupa
(dp)	diapausing -
(Dp)	Dauer -
(pp)	pre -
R-	resistant (strain)
RBE	relative biological effectiveness
Rev.	Review
RF	radio frequency
r.i.	radioisotopes (non-specified)
RNA	ribonucleic acid
mRNA	messenger RNA
tRNA	transfer RNA
RNase	ribonuclease
S-	susceptible (strain)
SMT	sterile male technique
T	temperature
TPN^+	triphosphopyridine nucleotide (oxidized)
uv	ultraviolet
I/120	Vol. I, reference 120
III/76	Vol. III, reference 76

Note: The following symbols may occur in the Subject Index:

IV	Roman numbers in connection with genetic effects indicate "chromosome, number IV".
QQ.2	After scientific name of insect: systematic code, referring to appropriate position in Table 1.
[PA.3]	After chemical compound: insecticide code, referring to appropriate position in Table 2.

ABBREVIATIONS

(Bibliographical Abbreviations for Abstract Sources)

AI	Biological and Agricultural Index
BA	Biological Abstracts
BAg	Bibliography of Agriculture
BB	Bulletin Bibliographique. Isotopes. Rayonnements. Agriculture.
BS	Bulletin Signalétique Hebdomadaire. Périodiques de Chimie.
CA	Chemical Abstracts
CC	Current Contents
DA	Dissertation Abstracts
LOR	Atomindex
NSA	Nuclear Science Abstracts
NSA/J	Nuclear Science Abstracts Japan
PDB	Pesticide Documentation Bulletin
RAE	Review of Applied Entomology

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The compiler (MB) is much indebted to Dr. D.L. Lindquist, of the Joint FAO/IAEA Division of Atomic Energy in Agriculture, for helpful discussions on insecticides.

1. RADIOISOTOPES

1.1. INSECT LABELLING

1.1.1. Methods

1 Anonymous. THE RADIOACTIVE GRASSHOPPER. Int. atom. Energy Ag. Bull. 8, 2 (1966) 14-16.

"--- They are fed on young wheat containing ^{192}Ir; the radioactivity taken up by the grasshoppers can then be observed by a portable scintillation counter. Laboratory tests have shown the biological period of the ^{192}Ir to be ~7d, and that ~1 μCi/insect is needed to enable them to be traced during two months".

2 Arroyo, M., Jiménez, A., Mellado, L., Caballero, F. APPLICACION DE ISOTOPOS RADIACTIVOS A LA INVESTIGACION DE METODOS SOBRE LUCHA BIOLOGICA CONTRA LAS PLAGAS. I. ENSAYOS SOBRE MARCADO DES ADULTOS DE Ceratitis capitata Wied., CON P-32. (Application of radioactive isotopes to the investigation of methods for the biological control of pests. I. Tests on marking adults of C. capitata Wied. with ^{32}P.) Boln Patol. veg. Ent. agric. 28 (1965) 233-240. (In Spanish)

The effects of supplying adults of C. capitata (Wied.) with radioactive phosphorus in their diet are described. Newly emerged individuals were given mashed banana, renewed every 2 d, into which ^{32}P had been incorporated at either 0.01 or 0.1 mCi per 5 g. The eggs laid were collected daily, and the larvae hatching from them were reared on mashed carrot. The ^{32}P had no influence on the mortality of the flies but appeared to stimulate oviposition, especially at the lower rate, though this may have been due to the addition of phosphorus to the diet and not to the radioactivity. The percentages of the total radioactivity supplied to the adults that could be detected in the eggs were 2.3 and 1.03 for the two rates, respectively. Screening the pupae derived from the two groups of eggs showed that they retained 62.8 and 44.6%, respectively, of the radioactivity present in the eggs; the corresponding percentages for the adults were 46.5 and 34.2. Adults derived from eggs laid 9 or 10 d after the ^{32}P had first been supplied to the parent flies were paired with each other and with adults derived from material to which no ^{32}P had been supplied, in all possible combinations, three males being confined with five females in each instance. Increased oviposition (as compared with the completely non-radioactive series) was observed when one sex (either male or female) was derived from the group supplied with the lower concentration and the other was from the untreated series, but when both sexes were of this group or one or both sexes were from the group supplied with the higher rate, there was a reduction in oviposition. Virtually no radioactivity was detectable in the eggs laid. (From RAE-A 55: 1967, ref. 252)

3 Arroyo, M., Jiménez, A., Mellado, L., Caballero, F. APPLICACION DE ISOTOPOS RADIACTIVOS A LA INVESTIGACION DE METODOS SOBRE LUCHA BIOLOGICA CONTRA LAS PLAGAS. II. ENSAYOS DE MARCADO DE LARVAS DE Ceratitis capitata Wied. CON P-32. (Application of radioactive isotopes to the investigation of methods for the biological control of pests. II. Tests on marking larvae of C. capitata with ^{32}P.) Boln Patol. veg. Ent. agric. 28 (1965) 241-256. (In Spanish)

Larvae of C. capitata in order to obtain labelled adults for studies on dispersion. Eggs were placed on mashed carrot containing 0.2 mCi ^{32}P per 15 g. The larvae hatched in 2-3 d, and nutritive solution was added daily from the 5th day, which somewhat reduced the radioactivity of the medium. The first pupae were formed on the seventh day. As a result of the progressive decrease in the radioactivity of the medium, the pupae formed on the 12th day were only half as radioactive as those formed on the 7th-9th. Adults were obtained from the 19th day and were supplied with food without ^{32}P. Their radioactivity was measured on the 19th, 22nd, 24th and 29th days, and it is concluded from the results that by this technique adults can be obtained that are radioactive to a measurable

degree (in the order of 0.01 μCi per adult) more than three weeks after the eggs are placed on the radioactive medium. Over 80% of the pupae gave rise to adults. Labelled adults could be distinguished easily and rapidly from normal ones in catches in trap-jars containing 2% ammonium phosphate and examined 6-8 d later, even when the contents of the traps had been filtered and stored for two days in test-tubes and the 'normal' adults had become very slightly radioactive as a result of contact with the labelled ones. When further tests were carried out with larvae using the same technique and rates of 0.4, 2 or 20 mCi. ^{32}P per 15 g food, no pupae were obtained with the highest rate and adults were obtained only with the lowest. When these adults were paired each way with normal adults or with each other, the number of eggs laid was lower than that obtained from normal adults if at least one of the sexes was from the labelled group. As the increase in oviposition obtained by labelling adults (as noted in the first paper) does not appear to occur when the larvae have been supplied with 0.4 mCi, this is considered a safe rate for labelling material for field release. Although pupae were formed when rates of 0.5, 0.6, 1 or 1.2 mCi per 15 g were used, no adults were obtained. Inconclusive results were given in a preliminary experiment to study the distances covered by individuals released in the field, but the radioactivity of the flies recaptured after 8 d was readily detected. (From RAE-A 55: 1967, ref. 253)

4 Baldwin, W.F., Allen, J.R., Slater, N.S. A PRACTICAL FIELD METHOD FOR THE RECOVERY OF BLACKFLIES LABELLED WITH PHOSPHORUS-32. Nature, Lond. 212 (1966) 959-60.

The report describes improved methods for tagging blackflies (Diptera: Simuliidae) in the larval and pupal stages, the use of a new trap for collecting large numbers of adults, and an autoradiographic technique for identifying radioactive individuals. A concentration of 1.2 μCi ^{32}P/ml water was used for labelling. An estimated total of 260 000 larvae and pupae were labelled. Two methods of detecting radioactive flies are described; 37 and 129 flies were detected by Marconi scaler and autoradiographs respectively. Adults giving < 10 cpm above background could be detected. The results at individual traps are tabulated, for a period of 2 weeks after treatment. The largest numbers of radioactive flies were captured in traps immediately above the tagging site, confirming visual observations that emerging flies tended to move upstream.

5 Chigarev, G.A. THE PRESENT STATE OF THE PROTECTION OF POTATO AGAINST THE COLORADO BEETLE IN THE USSR AND THE PROBLEMS INVOLVED. Trudy vses. Inst. Zashch. Rast. 17 (1963) 324-343. (In Russian, with English summary)

Mention is made in the report of experiments in which ^{60}Co-labelled adults were released in the field in the spring of 1960. The numbers were counted on the following day. Only 67% were recovered in three repeats, showing the ineffectiveness of visual inspection.

6 Dow, R.P. RADIOACTIVE YEAST FOR TAGGING MOSQUITOES. Bull. ent. Soc. Am. 13, 3 (1967) 202. Abstr. 331. "New York Meeting of the Entomological Society of America. New York, N.Y., USA, 27-30 Nov. 1967".

Radioactive yeast, prepared by fermenting dried yeast with sugar and ^{32}P, marked Culex nigripalpus mosquito larvae more uniformly and over four times as efficiently as the usual inorganic phosphate. Females so marked showed no reduction of egg production or hatchability at levels near 0.02 μCi.

7 Espinola, H.N., Silva, J.E., da. TAGGING SANDFLIES WITH ^{32}P (DIPTERA, PSYCHODIDAE). Revta bras. Biol. 25 (1965) 295-304.

A technique was developed for tagging sandflies with ^{32}P that could be used for studies of the ethology, biology, and ecology of these Psychodidae. Adults of Lutzomyia longipalpis (Phlebotomus longipalpis) were tagged with ^{32}P in the form of a $Na_2H^{32}PO_4$ solution added to the culture media. Two methods were tested for this purpose. The first consisted in tagging the adult sandflies through the 4th instar larvae (prepupal stage) by culture media containing 160, 80, 40, 20, 10, 5, and 1 μCi/g of ^{32}P. The second consisted in obtaining tagged adult sandflies by rearing them in the radioactive media from the egg stage. Since the insects in this group were expected to remain in the radioactive media for a longer time, the ^{32}P doses were reduced to 48, 24, 12, 6, 3, 1.5, and 0.3 μCi/g. Differences were found between the male and female counts that could be correlated with the inequality of weight and volume between the sexes. The ^{32}P radiation apparently did not cause any injury, either in morphology or in sandfly viability. The results of tagging adults starting from the eggs suggested that this method was preferable to the first, in view of the homogeneity of the counting results and

because it avoided transfer of larvae from one medium to another. The differences found between the counts of the first and the last sandflies to emerge were probably due to ^{32}P decay.(From auth. summary)

8 Garby, L., Yasuno, M., Phurivethaya, Y. LABELLING MOSQUITOES WITH RADIO-ACTIVE IODINE, ^{131}I. Trans. R. Soc. trop. Med. Hyg. 60, 1 (1966) 136.

Radioactive isotopes have been used to label insects for studies of their flight range and dispersal rates. ^{32}P, a β-emittor, has been most commonly employed, but its detection in insects is time-consuming and complicated. The authors report the successful use of ^{131}I, a γ-emittor, for labelling Culex pipiens fatigans. (From NM)

9 Hickman, C., Gates, J., Edmonds, E. FLY TAGGING: A NEW APPROACH. J. envir. Hlth 28 (1966) 277-282.

In December, 1963, a radioactive materials license was procured for 5 mCi of ^{32}P (at any one time) "to be used for the isotopic labelling of flies in manure piles on dairy and chicken ranches in Orange County in a study of fly propagation and dispersion". The procedures consisted of three phases. Phase 1 - Laboratory: A. Determine the optimum amount of ^{32}P to be ingested by larvae (min. - undetectable, max. - lethal), B. Determine the best laboratory media, Phase 2 - Field Experiments: A. Release and capture of laboratory flies to verify identification of laboratory flies, B. Tag larvae on chicken ranches to determine if laboratory tests were reproducible under field conditions; Phase 3 - Legal interpretations: A. Determine if intended procedures are legal, B. Determine admissibility of tagged flies as court evidence. Tagging of Musca domestica larvae for identification of fly breeding sited has produced better-than-expected results. The laboratory portion of the programme was very successful. The field programme can probably be improved by higher concentration of radioactive material, higher larvae concentration, and closer observation of the fly tapes. The experiment will not be complete until a favourable court decision is made using fly tagging as evidence.

10 Hickman, C., Gates, J., Edmonds, E. RADIOACTIVE FLY TAGGING. Pest Control 35, 4 (1967) 20-22.

Tagging (larvae) with ^{32}P was used to pinpoint breeding sites of Musca domestica L. in Orange County. Criteria for legal proof of breeding site to permit prosecution have not been established.

11 James, H.G. LOCATION OF UNIVOLTINE Aedes EGGS IN WOODLAND POOL AREAS AND EXPERIMENTAL EXPOSURE TO PREDATORS. Mosquito News 26, (1966) 58-63.

^{32}P was used as tagging agent to determine whether aedine eggs are subject to predation in the field. Two series of experiments were carried out; in June 1959 activated eggs of Aedes aegypti (L.) were tested, in June 1960 eggs of A. trichurus. In the 1st experiment ~100 000 eggs were immersed in a solution of 250 mCi ^{32}P/ml for 4 d at 2°C until individual eggs had reached 500 cpm. 1300 activated eggs were then put out in lots of 100 at random near pool margins. After 24 h insects and other arthropods were collected within the area and tested. In general eggs tended to be deposited by the mosquitoes at or near the margins rather on pool bottoms than that had little or no plant cover. Few eggs were present in soil above the high water contours though these were often well covered with vegetation subsequently. Predator feeding potential was tested in the laboratory. Adults of the beetle Bembidion frontale disposed of 15.7 of A. aegypti per day compared to 15.3 by B. muscicola and 5.1 by the ant Myrmica l. fracticornis. Species of Bembidion may therefore be more important than ants as predators.

12 Lee, W.R. FEEDING RADIOACTIVE ISOTOPES TO SPECIFIC LARVAL STAGES OF Drosophila melanogaster. Drosoph. Inf. Serv. 40 (1965) 101.

For a number of reasons it has proved desirable to pulse label (^{32}P) larvae during the first 24 h of the 3rd instar. The method is described in detail. Larvae are allowed to feed on labelled yeast for 24 h. Radioautographs of sperm from females inseminated by males treated in the manner described in the paper with either ^{32}P or ^{3}H-thymidine showed heavy uniform labelling during the first 3 d of mating yet the male germ cells had been subjected to radiation from radioactive media for only 1 d and during the relatively insensitive spermatogonial stage.

13 Peleg, B.A., Nadel, D.J. A METHOD OF P^{32} LABELING OF THE ARMORED AND SOFT SCALE PREDATOR Chilocorus bipustulatus L. Ktavim 16, 2 (1966).

Citrus fruits infested with immature (white-cap stage only) Egyptian black scale, Chrysomphalus aonidum (L.) (Diaspididae), were briefly dipped in a ^{32}P-solution (as orthophosphate in an isotonic solution containing phosphate buffer with pH 7, and a phosphorus content of 1 mg/ml). Only in this initial stage of its development will the total scale, dorsal armour and all, be consumed in great quantities daily by the lady beetle, C. bipustulatus L. (Coleoptera: Coccinellidae). The beetle is thus effectively marked. (A less permanent marking was achieved when radioactive material adhered to the beetle body.) The beetles were exposed to scale-infested fruit which had been dipped in ^{32}P-solution, with a specific activity of 0.01 mCi/ml and 0.05 mCi/ml for 48 and 96 h. Feeding upon ^{32}P-contaminated young scales did not affect beetle longevity, fecundity or egg viability. An effective half-life of 4.5 to 5.0 d was found in beetles fed on young scales treated with 0.01 mCi/ml, and 5.5 d when a 0.05 mCi/ml solution had been used. Most normal field studies could thus be carried out. With slight adaptations the method should prove suitable for labelling most scale insect predators.

14 Raimundo, A.C., Santos, L.R. COMBATE AOS INSECTOS. 1. A MARCAÇAO DA MOSCA DA FRUTA (Ceratitis capitata Wied.) COM FOSFORO RADIOACTIVO NO METODO DOS MACHOS ESTERILIZADOS. (Insect control. 1. Tagging the fruit fly Ceratitis capitata Wied. with radioactive phosphorus for the sterile male technique.) Estudos agron. 6, 3 (1965) 105-112. (In Portuguese)

In a preliminary study concerned with population analysis prior to attempting eradication of the sterile male technique, tagging was effected by ^{32}P mixed added to the larval medium. Four different concentrations (0.1, 0.3, 0.5 and 1 μCi/g) were used.

15 Rieffel, S.M., Crouse, H.V. THE ELIMINATION AND DIFFERENTIATION OF CHROMOSOMES IN THE GERM LINE OF Sciara. Chromosoma 19 (1966) 231-276.

The germ line chromosomes of S. coprophila have been followed from the time of origin of the germ cells up to the time of meiosis in the male and up to first larval moult in the female. The mechanism which prevents the accumulation of L (limited) chromosomes in the germ line is a unique process of chromosome elimination: it occurs in male and female embryos after the germ cells have migrated from the pole plasm to the definitive gonad site, and it involves the movement of whole L-chromosomes through the nuclear membrance into the cytoplasm. The extra paternal X-chromosome is eliminated from the germ cells at the same time and in the same manner. Following this elimination there is a cytological differentiation of the chromosomes remaining inside the nucleus. First, the four paternal homologues of the regular complement undergo a loosening of coils and become light-staining whereas the maternal homologues remain condensed like the L's. Next, the L-chromosomes undergo a process of extreme attenuation and dispersion following which they return to the condensed state. ^{3}H-thymidine autoradiography* on gonial and premeiotic cells in the testis reveals that the L-chromosomes undergo DNA replication at the end of the S period, also that there are asynchronies in DNA synthesis among the regular chromosomes. The phenomena of differential chromosome staining and asynchronous DNA replication are considered in the light of current theory regarding heterochromatization and gene inactivation, also in relation to the phenomenon of chromosome imprinting encountered in this genus.

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* In early experiments late 4th-instar larvae or young prepupae were injected with a solution containing 50 μCi/ml ^{3}H-thymidine (specific activity 1.88 Ci/mM), and kept until mid-pupal life when spermatogenesis occurred and the testes were dissected out. Because of high mortality following injection, later experiments used gonads given a 30 min exposure in a drop of tissue culture medium containing 10 μCi/ml ^{3}H-thymidine (specific activity 5 Ci/mM).

16 Ritossa, F.M., Atwood, K.C., Spiegelman, S. A MOLECULAR EXPLANATION OF THE BOBBED MUTANTS OF Drosophila AS PARTIAL DEFICIENCIES OF "RIBOSOMAL" DNA. Genetics 54 (1966) 819-834.

A high level of labelling was achieved by modifying the standard medium and adding ^{3}H-uridine. Eggs were labelled. Final preparations of pure ribosomal RNA had a specific activity ranging from 60 000 - 110 000 cpm/μg. All counting was done in a liquid scintillation counter on nitrocellulose membrane, permitting assay of ^{32}P and ^{3}H in the same sample. The proportion of DNA complementary to ribosomal RNA was estimated by means of annealing experiments in four bobbed (bb) mutants of independent

origin in D. melanogaster. All were found to be partially deficient in this DNA. These experiments, together with other evidence concerning the localization of this DNA and the characteristic of bb mutants, have led the authors to offer the conjecture that the bb locus is the nucleolus organizer and that the typical genetic basis of bb is partial delection of the nucleolus organizer.

17 Samostrel'skiĭ, A.I. et al. EXPERIMENT ON THE USE OF RADIOACTIVE ISOTOPES TO MARK Ornithodoros papillipes TICKS. Trudy Inst. Épidem.Pastera 29 (1966) 86-89.

Ticks can be labelled with radioactive isotopes from feeding on guinea pigs and retain their label for five months.

18 Taimr, L., Dlabola, J. VYUZITI RADIOFOSFORU PRO OZNACENI KRISU PRI STUDIU MIGRACE V TERENU. (Application of radiophosphorus for the marking of leafhoppers in the study of their migration.) Ochr. Rost. (No ?) 3 (1965) 75-83. (In Czech, with Russian and English summaries)

A method was developed for labelling leafhoppers (Javesella pellucida F. (=Calligypona)) with ^{32}P, by feeding on radioactive plants dipping into a $Na_2H^{32}PO_4$ solution. The penetration rate of the label into the insect and the feeding rate and sucking intensity were studied. An aqueous solution of $Na_2H^{32}PO_4$ with an activity of 30-50 μCi/ml, containing P up to 4 mg/ml proved useful in labelling for field work. The biological half-life was determined. Labelling had no noticeable effect on lifespan. Larvae labelled in the final stage of development retained their radioactivity. A method for marking and locating leafhoppers under field conditions is suggested.

19 Thygesen, T. RADIOAKTIV MAERKNING AF INSEKTER. (Radioactive labelling of insects.) Ugeskr. Land. 32 (1966) 531-537. (In Danish, with English summary)

Young plants of beet, swede, and winter rape were labelled with ^{32}P. One method consisted of splitting the stalk or stem, and fastening a small glass container with a ^{32}P-solution round it. (Other methods consisted in growing the plant in a pot, and watering the soil with a labelled solution, or injecting a labelled solution directly into the plant.) Aphids (Mysus persicae Sulz.) feeding on labelled plants became radioactive themselves. When feeding on small plants with only three to four leaves, a dose of 10 μCi ^{32}P was sufficient to effect labelling of the aphid. Older plants need a much larger dose for marking their aphid population. The amounts used had no retarding effect on development and reproduction of the aphids. When a labelled adult is removed from the labelled host plant, offspring are labelled - A scintillation counter was used.

20 Trout, W.E., III. THE SO-CALLED RECOVERY PHENOMENON AFTER IRRADIATION IN Drosophila melanogaster. Diss. Abstr. 27, 2 (1966) 646-B.

Methods are described for investigating the use of sperm by the male, by using ^{32}P and thymidine as sperm labels. By feeding or injecting males with ^{3}H-thymidine, and preparing squashes of the sperm transferred to females, the label transferred can be studied quantitatively by scintillation counting. The samples are also in a form suitable for chemical treatment, staining and autoradiography. Studies with injected adult males delayed in mating suggest that seminal fluid is accumulated to some extent in unmated males, and is used rapidly by mating males. Evidence concerning the time from injection or feeding of the label to the transfer of labelled seminal fluid or sperm to females, suggests that in these experiments the time is the same for ^{32}P and ^{3}H-thymidine labelling. Moreover, the time seems to be the same for males labelled as larvae, and as young adults. There appear to be two labelling peaks, one about 7-8 d after labelling, which may represent the use of labelled seminal fluid; and another peak 12-13 d after labelling, perhaps representing the 1st use of labelled sperm. The x-ray experiments offer strong evidence that the recovery phenomenon is the result of a radiosensitivity gradient in sperm used on different days after irradiation, and is not the result of an actual recovery process. The results from the labelling experiments are not inconsistent with this view. (From DA)

21 Trout, W.E., III. SCINTILLATION COUNTING OF TRITIATED THYMIDINE TRANSFERRED TO FEMALES BY LABELLED Drosophila melanogaster MALES. p. 61 of "Biology Division Semiannual Progress Report for Period ending January 31, 1966". ORNL-3922, Oak Ridge National Lab., Tenn. May 1966, 207p.

Adult males injected with ^{3}H-thymidine and mated daily lost 90% of their radioactivity within the first 3 d. About 1% of the label lost on each of these days was taken up by the females. Only 10%,

at most, of the female label was received through mating. At least 50%, and probably all, of the remaining label was received through ingestion of label excreted by the males and as surface contamination of the females. Male larvae which had been fed ^{3}H-thymidine for several hours and allowed to mate 4-8 d later as adults also transferred label to females during the first 2-3 d of mating. Although some of this transferred label was taken up by the female through ingestion, there are indications that much of the radioactivity was transferred through mating as labelled sperm and seminal fluid.

22 Vargas, L. THE USE OF LABELED MOSQUITOES FOR STUDYING POPULATION PROBLEMS. Boln. Inst. Estud. méd. biol. 22, 3 (1964) 443-451. (In Spanish)

The labelling of mosquitoes is a useful tool to estimate the size of populations, the daily survival, the dispersion rate or record travelling. It gives indications about the preference for shelters and a more accurate rate of human blood preferences. The results of the incidence of two characters, i.e. human blood index and resistance to DDT are discussed. Detailed consideration is given to infectious doses transmitted by mosquitoes and their chance distribution. All data available are used to estimate the risk of contracting one infectious dose. (NM)

23 Weidinger, N., Jahn, E. MARKIERUNG VON INSEKTEN MIT SELTENEN ERDEN ZUM STUDIUM VON FORSTSCHÄDLINGEN. (Insect labelling with rare earths for studying forest pests.) Anz. Schädlingsk. 39 (1966) 77. (In German). Anz. Schädlingsk. 38 (1965) 16. p. 291-294 of "Gemeinsame Tagung der Deutschen Gesellschaft für Biophysik E.V., Österreichische Gesellschaft für Reine und Angewandte Biophysik, Schweizerische Gesellschaft für Strahlenbiologie, Vienna, Austria 14-16 Oct. 1964."

Stable nuclides such europium, dysprosium and thulium were used to study the dispersal of certain pests. Labelling was carried out by spraying (field work), feeding or injection. Labelled insects were subsequently activated in a reactor. Rare earths can be detected with certainty with a gamma spectrometer down to $10^{-1}\gamma$, europium even down to $10^{-2}\gamma$.

24 West, A.S. p^{32} TAGGING AND RECOVERY OF BLACK FLIES. Bull. ent. Soc. Am. 12 (1966) 289. Abstr. 271 "Portland Meeting, Portland, Oreg. USA. 28 Nov. - 1 Dec. 1966".

Black fly adults, tagged with ^{32}P as larvae and pupae in aerated steamside tubs, have been recovered in significant numbers at distances of up to 3¼ miles by use of "sticky" traps and an autoradiographic technique. (Abstr.)

See also:

25 The effect of radioactive phosphorus on the growth and development of Culex pipiens molestus Forsk. (Diptera, Culicidae). (Abdel-Malek, A.S., 1961)
36 Mutations produced by transmutation of phosphorus-32 to sulfur-32 within Drosophila DNA. (Lee, W.R. et al., 1967)
39 Early developments in the use of radioisotopes in agriculture. (Comar, D.L., 1966)
41 Atomic energy in life sciences. (Gopal-Ayengar, A.R., 1966)
58 Biological half-life of Ca-45 in fall webworms. (Coleman, D.C. et al., 1967)
76 Distribution of ^{32}P in the male reproductive system of Culex pipiens quinquefasciatus (Say). (Patterson, R.S. et al., 1967)
428 Study of the structure and function of the alimentary tract of Megoura viviae Buckt. (Aphididae, Homoptera), with special reference to food uptake and honeydew excretion.) (Ehrhardt, P., 1963)
467 Some applications of radioactive isotopes in ecological research. (Noordink, J.P.W., 1965)
476 Study of food uptake by Megoura viciae Buckt., a phloem sucking aphid (Homoptera, Rhynchota). (Ehrhardt, P., 1961)
482 Labelling of aphid saliva with rubidium-86. (Lamb, K.P. et al., 1967)
489 Investigation of hibernation of Perillus bioculatus Fabr. tagged with ^{60}Co. (Wegorek, W. et al., 1965)
490 Habitat selection by the queens of two field-dwelling species of ants. (Wilson, O.E. et al., 1966)
493 Study of nutritional interchanges in the ant Formica polyctena by means of radioisotopes. (Lecomte, J., 1965)
495 Isotopes to estimate colony size of Formica cinerea Mayr (Hymenoptera:Formicidae) (Medler, J.T., 1964)
497 Note on the means of dispersion of Rhodnius prolixus Stål. (D'Ascoli, A. et al., 1966)

498 Some results obtained with the application of the tracer method in insect migration and dispersion studies. (Dlabola, J. et al., 1965)

499 Study of the dispersal of the nun moth, Lymantria monacha L., by means of rare earths. (Jahn, E. et al., 1966)

502 Flight range, lengths of gonotrophic cycles, and longevity of ^{32}P-labelled Anopheles stephensi mysorensis. (Quraishi, M.S., 1966)

503 Migration and dispersal patterns of Fe^{59}-labelled lone star ticks. (Smittle, B.J. et al., 1967)

504 Radioisotopes as tracers used for migration studies of the leafhopper species Calligypona pellucida F. (Taimr, L. et al., 1963)

554 Evaluation of activity of honeybee colonies moved to a lucerne seed field. (Šedivý, J. et al., 1966)

555 Definition of the range of host plants of the fruit fly (Oscinella frit L.) by means of ^{32}P in the feeds of the insects. (Taimr, L.et al., 1967)

558 Radiophosphorus in labelling the desert locust for population estimation. (El-Miniawi, S.F. et al., 1964)

568 Use of radioisotopes for studies on the ecology of tick vectors of disease. (Sonenshine, D.E., 1966)

954 Basic fertilization phenomena and gametic lethality in Drosophila. (Michigan State Univ., East Lansing, 1966)

1023 Drosophila cytology and genetics. (Oak Ridge National Lab., Tenn., 1966)

1288 Interactions of oxygen at high pressure and radiation in Drosophila. (Thomas, J.J., Jr. et al., 1966)

1556 Application of radioactive isotopes to the investigation of methods of biological control of insect pests. I-V. Tests with P-32 and gamma-rays on Ceratitis capitata. (Arroyo Varela, M. et al., 1965)

1609 Study on mass breeding and sterilisation of the Mediterranean fruit fly Ceratitis capitata Wied. (A contribution to the autocidal technique.) (Scherney, F. et al., 1967)

1611 Studies on the eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. IV. Mating behaviour and its frequency in the sterilized mosquitoes. (Tantawy, A.O., 1967)

1745 Plastic enclosures for in vivo radioassay of insects. (Lippold, P.C., 1967)

1791 "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology, Gainesville, Fla., 4 Oct. - 26 Nov. 1965" (FAO/IAEA, 1965)

1.1.2. Developmental, physiological, and genetic effects of isotopic labels

25 Abdel-Malek, A.S. THE EFFECT OF RADIOACTIVE PHOSPHORUS ON THE GROWTH AND DEVELOPMENT OF Culex pipiens molestus Forsk. (DIPTERA, CULICIDAE). Bull. ent. Res. 52, 4 (1961) 701-708.

In a study on the effect of different concentrations of ^{32}P in the larval medium on the growth and development of C. pipiens molestus, ^{32}P was found to have little noticeable effect on the growth of the larvae up to a concentration of 3.0 µCi ^{32}P/ml but above this concentration larval growth was greatly retarded. The period of larval development was increased at concentrations > 1.0 µCi ^{32}P/ml, and pupation occurred two weeks later than in the controls. In concentrations > 5.0 µCi/ml, pupation was completely inhibited, larvae became sluggish, stopped feeding and finally died. The effect of ^{32}P in the larval medium on the emergence and radioactivity of the resulting adults was also studied. On the basis of this study, it is recommended that, for efficient utilization of ^{32}P in large-scale field experiments, a concentration of ^{32}P of 1.0 µCi/ml be employed so that emerging adult mosquitoes may be sufficiently radioactive to be readily detectable. (Auth. summary)

26 Anil, Y.D. THE EFFECT OF THYMIDINE-^{3}H ON THE MORTALITY OF Drosophila melanogaster LARVAE. Istanb. Üniv. Fen. Fak. Mecm. B. 29, 3-4 (1964) 143-147.

Because the effect of radiation on organisms of different ages and on different tissues of the same animal is not the same, D. melanogaster larvae were used, since the number of cells in different tissues seems to be constant and no cell division occurs in postembryonal stages. 6-h-old larvae were transferred to hot nutrient (20 mg sugar, 20 mg yeast, 1 g banana and 60 µCi thymidine-^{3}H (I), maintained in it for 12, 24, or 48 h, and then transferred to normal nutrient. The number of dead and living larvae were

counted at intervals. I had a lethal effect on larvae; the longer the larvae were kept on I-containing nutrient, the greater was the mortality rate. A relation between the age of the larvae and the lethal effect of I was found. The radiation from I had a greater effect on the cells which were at the beginning of differentiation than on the cells with already established differentiation. (CA 64: 1966, 14565g)

27 Arroyo, M., Jiménez, A., Mellado, L., Caballero, F. APPLICACION DE ISOTOPOS RADIACTIVOS A LA INVESTIGACION DE METODOS SOBRE LUCHA BIOLOGICA CONTRA LAS PLAGAS. V. EFECTOS DE LA RADIACION GAMMA SOBRE PUPAS DE Ceratitis capitata Wied., PREVIAMENTE MARCADAS CON P-32. (Application of radioactive isotopes to the investigation of methods for the biological control of pests. V. The effects of γ-radiation on pupae of C. capitata previously labelled with ^{32}P.)

It was found impracticable to use larvae of C. capitata already labelled with ^{32}P as a source of pupae to be subjected to γ-radiation, since their vitality was so much reduced by the labelling that irradiation resulted in excessive adult mortality. (from RAE-A 55: 1967, ref. 256)

28 Bond, V.P., Feinendegen, L.E. INTRANUCLEAR ^{3}H THYMIDINE: DOSIMETRIC, RADIOBIOLOGICAL A. AND RADIATION PROTECTION ASPECTS. Hlth Phys. 12 (1966) 1007-1020. BNL-9435, Oak Ridge National Lab., Upton, N.Y.

It appears from a study of available data that the degree of early somatic biological effect from intranuclear ^{3}H is that anticipated on the basis of calculated average absorbed dose to the cell nucleus, at least down to doses of 5 rad or less. This result indicates that the absorbed dose concept holds down to the order of 10^{-11} g or less, and somatic effects can be predicted on this basis; the distribution of ^{3}H atoms incorporated into DNA as $^{3}HTdR$ (and ion pairs from the beta particles) are randomly distributed as far as dose calculations for the purpose of predicting somatic effects are concerned; every part of the cell nucleus lies within one ^{3}H β-range of some part of a chromatid, and the nucleus contains no sizeable contiguous insensitive volume of a radius exceeding the effective range of ^{3}H β-rays (1-2 μm); the origin of ^{3}H β-tracks in, or their close juxtaposition to the DNA molecule does not appear to enhance the degree of somatic effect. Transmutation effects of the disintegrating ^{3}H nuclide in DNA appear to have been demonstrated to produce genetic mutations in micro-organisms, and data suggestive of this mechanism in Drosophila are available. The degree to which this factor in addition to absorbed dose must be taken into account in estimating possible genetic effects in the mammal cannot be assessed adequately at this time, but appears to be small. From available data, it appears that the degree of genetic effect in mammalian cells can be approximated closely from the average absorbed dose to the nucleus. The intrinsic RBE of ^{3}H β-particles appears to be 1.0 (compared to 250 kVp x-rays), rather than the value of 1.7 currently used for radiation protection. (Auth.)

29 Caspari, E.W. SOMATIC MUTATIONS IN THE MOTH Ephestia. Report on Research, August 1, 1965 - September 15, 1966. p.4 in "NYO-2902-5 (and Suppl.), Rochester Univ., N.Y." 24p.

Injections of ^{3}H-thymidine into larvae 8 d after the last moult result in death within 6 h when 2 μCi are injected. With 1 μCi some animals survive several days. Their wing buds become reduced in size and finally disappear. No mitosis or incorporation of ^{3}H-thymidine was observed. At 0.5 μCi about 2/3 of the animals survive and pupate. The toxic effect seems to be due to the radioactivity, since equivalent amounts on non-radioactive thymidine are ineffective.

30 Dustan, G.G. EFFECTS OF TAGGING AMOUNTS OF RADIOACTIVE PHOSPHORUS ON ADULTS OF THE ORIENTAL FRUIT MOTH, Grapholitha molesta (Busck) (LEPIDOPTERA: TORTRICIDAE). Can. Ent. 98 (1966) 305-311.

Feeding adults on a tagging solution of ^{32}P containing 20-50 μCi/ml had no apparent effect on their longevity, mating, fecundity, and motility or on the viability of their eggs. The rate of 20-50 μCi/ml was in the range used for dispersal studies. Moths thus tagged had radioactivities of about 1500-2500 cpm. Female moths fed on solutions of ^{32}P at 100 μCi/ml showed counting rates of more than 5000 cpm. These females, when mated with normal males, laid approx. 38% fewer eggs than normal females. Also, the fertility of the eggs was reduced by about 25% when only the female parent was radioactive and 15% when only the male parent was radioactive to the extent of over 5000 cpm. (From auth.)

31 Ghelelovitch, S. EFFETS TUMORIGENES DE LA LEUCINE, DE L'URIDINE ET DE LA THYMIDINE TRITIEES CHEZ LES LARVES DE LA DROSOPHILE. C.R. hebd. Séanc. Acad. Sci., Paris 262, 10 D (1966) 1173-1176.

La substitution des composés tritiés à la leucine, l'uridine ou à la thymidine dans la nourriture des larves, permet d'augmenter l'incidence des tumeurs mélaniques chez les mouches d'une souche tumorale de D. melanogaster. A cet égard la thymidine tritiée est beaucoup moins active que l'uridine ou la leucine. L'uridine tritiée n'a pas permis d'induire la formation des tumeurs chez les larves d'une souche non tumorale. (Aut.)

32 Heslop, J.P. TOPICALLY APPLIED n-DECYL ACETATE AS A PRECURSOR FOR METABOLIC INVESTIGATIONS IN INSECTS. Nature, Lond. 213 (1967) 291.

The use of n-decyl 1-^{14}C-acetate was investigated on Calliphora erythrocephala, applied topically to 3 to 4-d-old larvae (1 µl). No effects on mortality, pupation or emergence were observed. The lack of time lag in the production of $^{14}CO_2$ (cf. II/266, on Musca domestica) was interpreted as rapid hydrolysis of n-decyl acetate, the free acetate produced being further metabolized as soon as it is absorbed by the insect. The use of a fat-soluble precursor therefore permits a water-soluble metabolite to be given to an insect, however small, in a dose smoothly applied over several hours without loss of blood, risk of mechanical damage or unnecessary metabolic disturbance.

33 Kaplan, W.D., Gugler, H.D., Kidd, K.K. DISTRIBUTION OF LETHALS INDUCED BY TRITIATED DNA PRECURSORS IN Drosophila melanogaster. Genetics 53 (1966) 499-511.

Sex-linked recessive lethals have been induced in male Drosophila by feeding ^{3}H-deoxycytidine to 1st-instar larvae. The lethals have been localized and their distribution compared to the one previously obtained with ^{3}H-thymidine. The two independently produced distributions differ from each other at the 4% level of significance. Two regional differences have been noted, one of high mutability after ^{3}H-thymidine and one of high mutability after ^{3}H-deoxycytidine. Data combined from the two treatments closely parallel the distribution of lethals induced by x-rays and γ-rays, suggesting that the combined distribution reflects the regional content of DNA along the X-chromosome. The differences in lethal distributions produced by the two DNA precursors suggest that significant local variations in thymine and cytosine content may exist within chromosomal DNA. (Auth.)

34 Lee, W.R., Oden, C.K., Bart, C.A., Debney, C.W., Martin, R.F. STABILITY OF Drosophila CHROMOSOMES TO RADIOACTIVE DECAY OF INCORPORATED PHOSPHORUS-32. Genetics 53, 5 (1966) 807-822.

Transmutation of ^{32}P to ^{32}S and the accompanying energy released by steric changes in the molecule and recoil of the ^{32}S nucleus have been separated from the mutagenic effect of accompanying β-radiation by storage of ^{32}P-labelled spermatozoa in unlabelled Drosophila females. Because of the high energy of the ^{32}P β-particle, only a negligible dose is received by sperm from β-radiation from 2-d-old males that had been fed ^{32}P as larvae. Females recently mated to ^{32}P-labelled males were divided into two groups. One group was allowed to produce progeny immediately. The other was first stored on sugar agar media at 18°C for three weeks to inhibit oviposition, and then permitted to oviposit freely on cornmeal media. The mutation rates of progeny of the two groups were compared to measure additional genetic damage, if any, caused by ^{32}P decay in sperm during the storage period. There was no significant change during storage in the rate either of chromosome breakage (as measured by loss of the marker B^{S} on the marked B^{S} Y-chromosome) or of sex-linked recessive lethals that could be attributed to transmutation and recoil. By combining the min. increase in mutation rate that could have been detected statistically with the minimum estimate of ^{32}P disintegrations, it was concluded that less than one ^{32}P disintegration in 2000 in the X-chromosome will produce a "complete" recessive lethal. (From auth. summary)

35 Lee, W.R., Sega, G.A., Alford, C.F. THE PRODUCTION OF MOSAICS BY INCORPORATION OF P^{32} INTO DNA OF Drosophila melanogaster SPERMATOZOA. Genetics 56, 3 Pt.2 (1967) 572. Presented at the "1967 Meetings of the Genetics Society of America. Stanford, Calif., 31 Aug. - 2 Sep. 1967".

The effect of transmutation of ^{32}P to ^{32}S in DNA was separated from the mutagenic effect of accompanying β-radiation as in a previous experiment (Genetics 53: 1966, 807-822) by storage of ^{32}P labelled spermatozoa in unlabelled females. The multipurpose breeding scheme used in this experiment was designed to detect: (1) F_1 females with completely mutant germ lines by scoring for sex-linked recessive lethals in the F_2, and F_1 females with mosaic germ lines by scoring for sex-linked recessive lethals in the F_3; (2) F_1 males either complete or mosaic for loss of a Y-chromosome marked with y+. The results confirmed the earlier experiment in that there was no increase in the rate of either complete or partial

loss of the marked Y-chromosome or of sex-linked recessive lethals scored in the F_2 during 23 d of storage. However sex-linked recessive lethals scored in the F_3 generation increased significantly from 0.6% (N = 2247) to 1.5% (N = 2479) during the 23 d the spermatozoa were stored in unlabelled females. The frequency of mutant cleavage nuclei in these mosaics must be less than 50% and is best fit by 12% or less because, as shown in a previous experiment (Genetics 55:1966, 619-634), the F_2/F_3 ratio would be 2.4 if mosaic embryos had averaged 50%, whereas the F_2/F_3 ratio would be reduced to 0.6 if mosaic embryos averaged 12%. (Abstr.)

36 Lee, W.R., Sega, G.A., Alford, C.F. MUTATIONS PRODUCED BY TRANSMUTATION OF PHOSPHORUS-32 TO SULPHUR-32 WITHIN Drosophila DNA. Proc. natn. Acad. Sci. USA 58, 4 (1967) 1472-1479.

To determine the proportion of ^{32}P incorporated into DNA, sperm cells were double-labelled with ^{32}P and ^{3}H-thymidine. Evidence is presented that transmutation of ^{32}P to ^{32}S within the DNA molecule of Drosophila spermatozoa produce lethal mutations that are detected only in the F_2. If the delay in expression of the lethal mutation is due to F_1 mosaicism, the mutant cells must average 25% or less of the F_1 mosaic fly, or otherwise a significant fraction of the lethals will be detected in the F_2. Mosaics of 25% or less may be the results of multistrandedness or the mechanism of mutation. Regardless of which explanation may be correct, it is clear that the conventional explanation for the origin of mosaics by the alteration of one strand of double-stranded DNA to produce a cell lineage with half mutant and half nonmutant cells cannot be applied to these mutation induced by transmutation of ^{32}P to ^{32}S. The implications for estimating genetic damage from radionuclides incorporated into DNA must be re-evaluated in view of these results. Furthermore, these results indicate the inadequacy of conventional F_2 lethal tests for screening potential mutagenic agents.

37 Strayer, J.R. EFFECT OF RADIOPHOSPHORUS (P^{32}) ON LIGHT RESPONSE OF Aedes aegypti (L.) LARVAE. Fla Ent. 48, 2 (1965) 81-84.

The normally negatively phototactic larvae of A. aegypti (L.) were exposed to varying levels of ^{32}P in order to determine whether this would affect their light responses. 3rd-instar larvae were kept for 24 h in beakers containing 250 ml water either alone or with the addition of 1 ml of a 0.5 N solution of orthophosphoric acid, or radioactive material giving 0.1 or 5 μCi ^{32}P/ml. The larvae were then transferred to fresh water and provided with food. For observations on light responses, which were carried out in a darkened room, an 18 in. cylinder was used, a trap funnel being fixed in an upright position about half-way up. The bottom of the funnel was closed or opened by a stopper operated by a string that passed through a drain plug at the base of the cylinder. The cylinder, which was lit initially from below, was filled with water and the funnel was closed. Larvae was poured in through the top, and when they had settled, the funnel was opened and the bottom light was turned out. After a few seconds' pause, a top light was turned on for 20 sec, after which the funnel was immediately closed. The larvae in the top and bottom parts of the cylinder were counted separately, and their radioactivity was determined. No differences in the level of radioactivity were detected between those larvae in the top section and those in the bottom. However, the average percentages of larvae in the top were 29.6 and 26 for those that had been kept in water and in the non-radioactive orthophosphoric acid solution respectively, as compared with 43.6 and 67 for those exposed to 0.1 and 5 μCi ^{32}P/ml, indicating that these concentrations of radioactive phosphorus affected the light response of the Aedes larvae. (From RAE-B55: 1967, ref. 171)

See also:

3 Application of radioactive isotopes to the investigation of methods for the biological control of pests. II. Tests on marking larvae of C. capitata with ^{32}P. (Arroyo, M., 1965)

15 The elimination and differentiation of chromosomes in the germ line of Sciara. (Rieffel, S.M. et al., 1966)

74 A study of the retention and the mutagenic mode of action of radioactive phosphorus in Drosophila melanogaster. (Oftedal, P., 1959)

75 Some aspects of transmutation studies in Drosophila. (Oftedal, P. et al., 1967)

292 Genetic and radioautographic evidence for a DNA-containing body in the cytoplasm of the adult testes of Drosophila melanogaster. (Kaplan, W.D. et al., 1967)

501 Flight range, lengths of gonotrophic cyles, and longevity of ^{32}P-labelled Anopheles stephensi mysorensis. (Quraishi, M.S. et al., 1966)

950 Molecular and radiation genetics. Annual Report 1965 (Leiden Rijksuniversiteit, Netherlands. 1966)

1429 Effect of tritiated thymidine and irradiation on the mortality of adult Drosophila melanogaster larvae. (Bolukbasi, E.K., 1965)

1.2. INSECT PHYSIOLOGY AND BIOCHEMISTRY

1.2.1. General Articles, Surveys

38 Anonymous. RADIOISOTOPES IN TROPICAL MEDICINE. Wld Hlth Orgn, Chron. 17 (1963) 83-96.

Numerous applications of radioisotopes in biological and medical problems of the tropics are reviewed. In tropical medicine four phenomena appear repeatedly in varied combinations: infection, diarrhea, malnutrition and anemia. Infection and malnutrition interact particularly closely. Isotope techniques have proved invaluable in studies of every aspect of water and electrolyte physiology, the most useful methods so far being based on the dilution principle. ^{24}Na, ^{42}K, and ^{82}Br (used as a chloride substitute) and deuterium or ^{3}H are the isotopes most often employed in such studies. Radioisotopes such as ^{55}Fe, ^{59}Fe, ^{51}Cr, and vitamin B_{12} labelled with ^{60}Co have proved useful in the analysis and separation of conditions that exist in South-East Asia. These isotopes facilitate the study of haemolysis by providing estimates of the life span of red cells and the pattern and sites of their destruction. A table shows the various isotopes that have been incorporated into insects. Those most often used for ecological investigations are the β emitters ^{32}P, ^{35}S and ^{89}Sr. Tracer techniques and insect biochemistry are also discussed, whereby the use of radioactive labelled insecticides enables their metabolic fate in insects to be followed with great sensitivity and specificity, and throwing much light on the mechanism of insect resistance. (NSA 19: 1965, 34094)

39 Comar, C.L. EARLY DEVELOPMENTS IN THE USE OF RADIOISOTOPES IN AGRICULTURE. Isotopes Radiat. Technol. 4, 1 (1966) 53-58.

Very general survey of early developments in the uses of radioisotopes in agriculture. These uses, particularly for research studies in plants, animals, soils, waters, and insects, have expanded enormously in the last 20 yr, and a few are indicated briefly. An ever increasing use of nuclear energy techniques in biological and agricultural research is evident and the trend will continue, in view of the variety of radioisotopes instrumentation and equipment available today.

40 Gilbert, L.I., Schneiderman, H.A. SOME BIOCHEMICAL ASPECTS OF INSECT METAMORPHOSIS. Am. Zool. 1 (1961) 11-51.

Comprehensive review article with extensive bibliography. The article is divided into sections on hormones and metamorphosis (including a chapter on hormone identification dealing with the chemical nature of the brain hormone, the prothoracic gland hormone, the juvenile hormone, the egg-diapause hormone, and queen substance), chemical changes during metamorphosis (amino acid content, proteins, peptides, metabolisms of proteins and amino acids, carbohydrates, glycolysis, lipids, lipid metabolism, nucleic acids, other phosphate compounds, and inorganic ions), and hormone action (mode of action of ecdysone, brain hormone, and juvenile hormone). — Radioisotopes had been utilised in many of the studies cited but this fact scarcely emerges from the text.

41 Gopal-Ayengar, A.R. ATOMIC ENERGY IN LIFE SCIENCES. Atom. Energy Rev. 4 (1966) 59-71. Commemorative Issue.

In surveying the impact of atomic energy on the life sciences, the author discusses particularly the various uses of isotopes in biology and biochemistry, instancing in some detail the effectiveness of tracers as a research tool. He touches on such subjects as the use of isotopes in revealing the processes of plant growth and nutrition, in eradicating insect pests, in improving agriculture and in promoting health and combating disease. (From auth.)

42 Haisch, A., Suess, A. DIE VERWENDUNG VON RADIONUKLIDEN UND DEREN STRAHLUNG IN DER SCHÄDLINGSBEKÄMPFUNG. (The use of radionuclides and their radiation in (the) plant pest control.) Kerntechnik 8 (1966) 514-517. (In German)

The use of labelling techniques to determine the relation between plant, plant pest, and environment to ensure a more effective use of pesticides is discussed. The use of ionizing radiation for killing sterilising plant pests is also discussed. Pest sterilisation is considered in some detail with the discussion of the modification of the sterilisation by endo- and exogenic factors, and a review of the results obtained in sterilisation studies is given. The desirability of applying the method to some pests in Germany is pointed out.

43 Harvey, W.R., Haskell, J.A. METABOLIC CONTROL MECHANISMS IN INSECTS. p.133-205 of "Advances in Insect Physiology. Vol.3". Beament, J.W., Treherne, J.E., Wigglesworth, V.B., Eds. London, Academic Press. 1966. 382p.

This review article is broken down into sections on phosphate acceptor and substrate control of respiration in isolated mitochondria (dealing with sarcosomes and their isolation, energy requirements of insect flight, regulation of energy trapping pathways in flight muscle, oxidative phosphorylation and respiratory control, endogenous uncoupling or controlling agents, α-glycerophosphate and respiratory control during flight, and biological factors influencing energetics of mitochondria); the regulation of enzyme levels (constant proportion enzymes, oxidative enzymes in silkworm development, and enzymes of tanning reactions); control at the chromosome level (the biochemistry of insect hormones and of giant chromosomes, chromosomal puffing and its relation to development and to synthetic processes in the cell, ecdysone and DNA synthesis, and chromosomal puffs and transport); and the ionic control of protein synthesis and development (ion control during development, and protein synthesis regulated by ion concentrations). An extensive bibliography is attached. Radioisotopes were used in a large number of studies, particularly those dealing with puffing phenomena).

44 House, H.L. INSECT NUTRITION. A. Rev. Biochem. 31 (1962) 653-672.

A review of the understanding of nutritional requirements, e.g. the chemical factors of ingested food essential for normal metabolism and development of the insect and the insight into insect metabolism arising from nutritional research. Tracer techniques are carried out in some of the studies reviewed, using ^{14}C-labelled compounds. (81)

45 Kansu, A. RADIOISOTOPES IN ENTOMOLOGY. Yüks. Zir. Enstit. Derg. (1964) 7-28. (In English)

This paper is mainly based on the author's lecture notes for the International Training Course in Radioisotopes in Agriculture, jointly sponsored by the I.A.E.A. and the Atomic Energy Commission of the Republic of Turkey, Ankara, Oct. 2 - Nov. 25, 1962. (See also II/1575)

46 Mitchell, H.K. BIOCHEMICAL ASPECTS OF Drosophila. A. Rev. Genet. 1 (1967) 185-200.

A review with 114 references.

See also:

1536 Role of atomic energy in insect study and control. (Huque, H., 1962)
1791 "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology, Gainesville, Fla., 4 Oct. - 26 Nov. 1965". (FAO/IAEA, 1965)

1.2.2. Elements. Ions. Inorganic Salts

47 Aidley, D.J. THE EFFECTS OF STRONTIUM AND OTHER DIVALENT CATIONS ON POTASSIUM CONTRACTURE IN A LOCUST LEG MUSCLE. J. Physiol. Lond. 77 (1965) 103-111.

It was previously established that Ca ions are necessary for the production of K-induced contractures in the mesothoracid extensor tibialis muscle of the locust Schistocerca gregaria, and present experiments investigated whether other divalent cations would substitute for Ca in this reaction. Ringer's solutions containing these abnormal cations were made by substitution of the cation for Ca, and contractures were produced by perfusion of the muscle with a solution containing 164-mM KCl and 100-mM D-glucose. Addition of salts of Sr, Co, and Ni to Ca-depleted muscle in KCl solution caused a brief submaximal contraction. Salts of Mg, Ba, and Mn did not produce contraction under these conditions. After perfusion

of a Ca-depleted muscle with a Ca-free Ringer's solution containing 4 m$\underline{M}$ $SrCl_2$, perfusion with KCl solution causes a phasic contracture which may reach 25% of the max. tension produced under normal conditions of Ca ion concentration. Successive responses to depolarization in the presence of Sr ions decline in the absence of Ca ions. It is concluded that Ca is probably uniquely important in excitation-contraction coupling in this muscle, and that Sr and other substitute cations act by displacing Ca from some site at which it is bound in the muscle. The comparative physiology of Sr ion action in excitation-contraction coupling is discussed. In the frog heart, Sr and Ba salts are similar to Ca salts in their effects on contractility, and ^{89}Sr can be used as a tracer for Ca. There is some competition between Ca and Sr ions, and higher tensions are produced in a Ca-free Ringer containing Sr ions than in normal Ringer solution. At low Ca^{2+} concentrations, the presence of Sr ions causes an increase in the contraction of cat papillary muscle which was associated with a lengthening of the R-T interval of the electrocardiogram. Sr and Ba ions can substitute for Ca to some extent in the uterine muscle of the rat, but the muscle appears to distinguish Ca from Sr in that after a brief exposure to Ca ions the ability to produce contracture persists for some time, whereas this does not occur after a similar exposure to Sr ions. There are many differences between the actions of Sr and Ca ions on vertebrate muscles, but these differences are fewer than are seen in locust muscle, where Sr is far from being an adequate substitute for Ca. (NSA 19: 1965, 33725)

48 Auerbach, S.I., Crossley, D.A. Jr., Dunaway, P.B. et al. RADIOACTIVE WASTE AREA AND RADIATION EFFECTS STUDIES. p. 81-96 of "Health Physics Division Annual Progress Report for Period Ending June 30, 1963". ORNL-3492, Oak Ridge National Lab., Tenn. 30 Sep. 1963. 245p.

A variety of studies is discussed. The use of biological elimination of radioisotopes in insects as indirect measures of metabolism under field conditions was continued with emphasis on the influence of temperature on elimination rates. In geometric caterpillars the biological half-life of ^{137}Cs was decreased by one-half for a 10°C rise in temperature. Similar temperature-related trends were found for leaf beetles (Chrysomela knabi) and millipedes (Dixidesmus erasus).

49 Cavalloro, R., Cirio, U. ACCUMULO ED ELIMINAZIONE DI RADIOISOTOPI IN ALCUNE SPECIE DI INSETTI FITOFAGI OLOMETABOLI. (Accumulation and elimination of radioisotopes in several species of phytophagous holometabolous insects.) Redia 49, 2 (1964/5) 239-253. (In Italian, with English summary). Presented at the "VI Congresso Nazionale di Entomologia, Padova, Italia. 11-14 settembre 1965."

The fate of ^{85}Sr, ^{137}Cs, and ^{131}I was studied in various stages of the life cycle of nine species of phytophagous insects belonging to the families of Noctuidae (Scotia segetum Schiff. and others), Thaumetopoeidae (Thaumetopoea pityocampa Schiff.) and Scarabaeidae (Melolontha melolontha L.). Insects were labelled by feeding on labelled plants or solutions. Iodine was translocated most rapidly, followed by Cs and Sr. Data are given on the accumulation, elimination, and biological half-life of the radionuclides. Uptake was regular in Thaumetopoeidae and Scarabaeidae, although equilibrium failed to be reached, whereas it was very irregular in the Noctuidae. ^{131}I accumulated more rapidly than ^{137}Cs, and ^{137}Cs more rapidly than ^{85}Sr. Elimination curves were always regular and demonstrated, for all life stages, a more rapid loss for ^{85}Sr, followed by ^{137}Cs and then ^{131}I. ^{131}I was found in large concentrations in the exuviae which indicates preferential utilization of the element in the cuticle. Biological half-life data varied greatly with species and stage in the life cycle.

50 Cavalloro, R., Cirio, U. ACCUMULO ED ELIMINAZIONE DI RADIOISOTOPI IN ALCUNE SPECIE DI INSETTI FITOFAGI OLOMETABOLI. (The accumulation and elimination of radioisotopes in some species of phytophagous holometabolic insects.) p. 78-79 of "6th Italian National Congress of Entomology. Padua, Italy, 11-14 Sep. 1965". Abstract of Paper Presented at the Meeting. Published 1966.

Insects were labelled either by ingestion of a sugar solution to which radioisotopes had been added or by feeding on labelled plants. Translocation in the plant was found to be greatest for I, less so for Cs, and slowest for Sr. A table was presented giving accumulation, elimination rates and the average biological half-life of the various isotopes in the insect species under consideration. The values were compared with those reported for other insect species. ^{131}I accumulates faster than Cs or Sr. No equilibrium was observed. Elimination was most rapid for ^{85}Sr, followed by ^{137}Cs and ^{131}I. Iodine proved most mobile. It was found in large quantities in the exuvia, and is evidently utilized in the cuticle. 28 biological half-life values were found for the three radioisotopes: 12 each for Sr and Cs and 4 for I, depending on the various stages of the life cycle.

51 Cavalloro, R. THE ACCUMULATION, DISTRIBUTION, AND ELIMINATION OF ^{85}Sr, ^{131}I, AND ^{137}Cs IN VARIOUS INSECT SPECIES. p. 601-608 of "Proceedings of the International Symposium on Radioecology, Concent. Processes". Stockholm 1966. Published 1967.

Several species of Lepidoptera, Coleoptera, Hymenoptera, Orthoptera, and Homorocoryphus were examined. Included were absorption by exoskeleton, haemolymph, salivary glands, gut, malpighian tubules, fatty tissue, muscle, and nervous system. Also included were body-burden determinations at intervals up to 168 h after ingestion of labelled food. No conclusions were drawn. (CA 68:1968, 19311 c)

52 Cavalloro, R., Cirio, U. ACCUMULO ED ELIMINAZIONE DI RADIOISOTOPI IN ALCUNE SPECIE DI INSETTI FITOFAGI OLOMETABOLI. (Accumulation and elimination of radioisotopes in some species of phytophagous insects.) Euratom Inf. 4, 10 (1966) 1089.

The movement of ^{85}Sr, ^{137}Cs and ^{131}I has been studied in various stages of the life-cycle of nine species of phytophagous insects from the families Noctuidae, Thaumetopoeidae and Scarabaeidae. The insects were labelled through feeding on labelled plants or solutions. Labelling the plants indicated that I was translocated most rapidly, then Cs and then Sr. Data are given on the accumulation, elimination and biological half-life of the three radionuclides. Uptake was regular in the Thaumetopoeidae and Scarabaeida, although equilibrium was not reached, whereas it was very irregular in the Noctuidae. ^{131}I was accumulated more rapidly than ^{137}Cs and the latter more so than ^{85}Sr. Elimination curves were always regular and demonstrated, for all life stages, a more rapid loss for ^{85}Sr, followed by ^{137}Cs and then ^{131}I. The latter isotope, more strongly retained, was found in large concentrations in the exuviae which indicates a preferential utilization of the element in the cuticule. Data on biological half-lives were quite variable as to species and life-cycle. (NM)

53 Cavalloro, R., Cirio, U. DISTRIBUZIONE DI STRONZIO, CESIO E IODIO RADIOATTIVI NEL CORPO DI ALCUNI INSETTI. (The distribution of radioactive strontium, caesium and iodine in the body of some insects.) Redia 50 (1966/1967) 187-196. (In Italian, with English summary)

The distribution of ^{85}Sr, ^{137}Cs, and ^{131}I was investigated in larvae of ten species and adults of 11 species of insects belonging to the following groups: Orthoptera (Conocephalidae, Tettigoniidae, Gryllidae, Gryllotalpidae and Acrididae), Lepidoptera (Noctuidae, Thaumetopoeidae, Saturniidae, Lasiocampidae, Papilionidae and Pieridae), Coleoptera (Silphidae), and Hymenoptera (Argidae)*. The radioisotopes were administered by ingestion of labelled food or solutions. The insects were fasted prior to dissection. Tissues analysed for accumulation were exoskeleton, muscles and nervous system, alimentary canal (gut), salivary glands, haemolymph, gonads, fat body, and Malpighian tubules. The distribution of Sr and Cs was generally similar. ^{85}Sr and ^{137}Cs accumulated primarily in the muscles and nervous system and in the haemolymph; some differences related to their respective mobilities were noted. There was a higher accumulation of ^{137}Cs in the gonads of the Lepidopteran species (14.3%) than in those of the Orthopteran species (3.1%). In the holometabolic species ^{137}Cs and ^{85}Sr accumulated mostly in the gut. ^{131}I accumulated primarily in tissues with high lipid content, i.e. the fat body and exoskeleton.

* In the adult and larval stages of Phytometra gamma L., Rhyacia c-nigrum L., Scotia segetum Schiff., and Triphaena pronuba L., the adult stages of Ephippiger ephippiger Fieb. Gryllotalpa gryllotalpa L., Gryllus campestris L., Homorocoryphus nitidulus Scop., Necrophorus sp., Oedipoda coerulescens L., and Trigonophora meticulosa L.; and the larval stages of Arge pagana Panz., Endia pavonia L., Macrothylacia rubi L., Papilio machaon L., Pieris brassicae L., and Thaumetopoeca pityocampa Schiff.

54 Cavalloro, R., Cirio, U. DISTRIBUZIONE DI STRONZIO, CESIO E IODIO RADIOATTIVI NEL CORPO DI ALCUNI INSETTI. (Body distribution of radioactive strontium caesium and iodine in some insects.) Redia 50 (1967) 187-196. (In Italian)

The distribution of ^{85}Sr, ^{137}Cs and ^{131}I was investigated in larvae of 10 species and adults of 11 species of insects belonging to the following groups: Orthoptera (Conocephalidae, Tettigoniidae, Gryllidae, Gryllotalpidae and Acrididae), Lepidoptera (Noctuidae, Thaumetopoeidae, Saturniidae, Lasiocampidae, Papilionidae and Pieridae), Coleoptera (Silphidae), Hymenoptera (Argidae). The radioisotopes were administered by ingestion of labelled food or solutions. The insects were fasted prior to dissection. The distribution of Sr and Cs were generally similar. They were concentrated preferentially in muscle and in the nervous system, with some differences related to their respective mobility. In the holometabolic species, however, these isotopes were found mostly in the gut. I was associated mostly with the lipids, either in the fat body where important or in the exoskeleton.

55 Cavallero, R. DATA ON THE ACCUMULATION, DISTRIBUTION AND ELIMINATION OF ^{85}Sr, ^{131}I AND ^{137}Cs IN VARIOUS INSECT SPECIES. p.601-608 of "Radioecological Concentration Processes. Proceedings of an International Symposium. Stockholm, Sweden, 25-29 April 1966". Pergamon, Oxford, 1966.

Tabulated data are presented on (1) the biological half-life of the above isotopes in larvae and adults of various insect species, belonging to Lepidoptera (Noctuidae and Thaumetopoeidae) and Coleoptera (Scarabaeidae); (2) the distribution of the radioisotopes in last-instar larvae of Scotia segetum Schiff and Thaumetopoea pityocampa Schiff following ingestion of labelled food; (3) the distribution of ^{85}Sr in various last-instar larvae after ingestion of labelled food; (4) of ^{131}I; and (5) of ^{137}Cs; (6) the distribution of ^{85}Sr, ^{131}I and ^{137}Cs in adults of Homorocoryphus nitidulus Scop. and Triphaena pronuba L. following ingestion of labelled food; (7) distribution of ^{85}Sr in various adult insects after ingestion of labelled food; (8) of ^{131}I; (9) and of ^{137}Cs. Graphs are given of (1) the body-burden of ^{85}Sr and ^{137}Cs in last-instar larvae of S. segetum and Triphaena pronuba, feeding on labelled plant leaves, as a function of time; (2) daily uptake of ^{85}Sr and ^{137}Cs by last-instar larvae feeding on labelled plant leaves. Daily uptake = net increase in body activity + activity of liquid and solid excrements produced over 24 h; (3) specific activity of ^{85}Sr and ^{137}Cs in solid excrements in last-instar larvae feeding on labelled food; and (4) loss curves of ^{85}Sr, ^{131}I and ^{137}Cs in last-instar larvae and adults after ingestion of labelled food.

56 Chaplain, R.A. THE EFFECT OF Ca^{2+} AND OF FIBRE ELONGATION ON THE ACTIVATION OF THE CONTRACTILE MECHANISM OF INSECT FIBRILLAR FLIGHT MUSCLE. Biochem. biophys. Acta 131, 2 (1967) 385-392.

The relationship between fibre length and the Ca^{2+}-activated ATPase (adenosine triphosphate phosphohydrolase, EC 3.6.1.3) of insect fibrillar muscle was studied on the dorsal longitudinal muscles of the giant water bugs Lethocerus cordofanus and Hydrocyrius columbiae, the beetle Amphimallon solstitialis and the bumble bee, Bombus lucorum. Fibre bundles which had been stretched by the required amount in the relaxing solution were immediately transferred to an activating solution containing 3.55×10^{-9} M Ca^{2+}, and allowed to equilibrate. Stabilized ^{45}Ca concentrations were obtained by adding ^{45}Ca-EGTA, prepared by combining $^{45}CaCl$ and EGTA in equivalent concentrations. The amount of bound ^{45}Ca was determined, special care being taken to reduce the contaminating unlabelled Ca^{2+} present in the reagents used in the ^{45}Ca-binding studies. Low levels of Ca^{2+} and small degrees of fibre extension have been found to increase the ATPase activity. Either factor influences the sensitivity of the material to the other factor. In insect fibrillar muscle, where the A filaments are continuous with the Z line, it is possible to strain the A filaments directly in the absence of permanent actin-myosin interactions. The higher ATPase activity as a result of fibre elongation is accompanied by an increase in Ca^{2+} binding. The relevance of the findings to the mechanism of oscillatory contraction of insect fibrillar muscle is discussed.

57 Coleman, D.C., Monk, C.D. THE BIOLOGICAL HALF-LIFE OF 45-CALCIUM IN THE FALL WEBWORM, Hyphantria cunea (Drury). Bull. ecol. Soc. Am. 48, 3 (1967) 129.

58 Coleman, D.C., Monk, C.D. BIOLOGICAL HALF-LIFE OF Ca-45 IN FALL WEBWORMS. "New York Meeting of the Ecological Society of America. New York, N.Y. Dec. 26-31, 1967". AED-CONF-1967. 396-001. 5p.

The uptake, assimilation and loss of Ca by Hyphantria cunea (Drury) was studied after allowing them to feed on persimmon trees which had been labelled by injecting 2 mCi of ^{45}Ca into holes in the trunk. Values for biological half lives from last-instar larvae were determined under varying experimental conditions, and proved extremely labile. The assimilation rates were determined by micro-bomb calorimetry of leaves and faeces. It proved to be very low, with a fairly rapid flux of assimilated isotope (~ 11%/d for the fed larva).

59 Cornwell, P.B. A PRELIMINARY INVESTIGATION INTO THE UPTAKE AND TRANSLOCATION OF PHOSPHORUS IN Theobroma cacao L. Trop. Agric., Trin. 34, 2 (1957) 117-132.

^{32}P was introduced as carrier free phosphorus in the chemical form of orthophosphoric acid. It was administered by trunk implantation, the immersion of roots and application to the soil. Radioactive assay showed that the distribution of activity in the trunk and branches was influenced by the location of the holes of implantation and of the roots engaged in absorbing the active material. There was

little lateral movement in the conducting vessels of the trunk so that only those branches which originated near the path of translocation took up ^{32}P. It would appear that the most uniform distribution of activity in the trees is obtained after application to the soil. The distributions and levels of activity in the branches are considered in relation to the suitability of these techniques for labelling the mealybug vector, Pseudococcus njalensis Laing, of cacao virus at their feeding sites in the field. No activity could be detected in the immature stages. Considerably higher levels of activity than those employed in the present work are required in the branches before such insects can be used in ecological studies. Ants, Crematogaster striatula Emery, attending the mealybugs on these trees gave counts two or three times higher than those obtained from adult P. njalensis. The results are of further interest in relation to other fields of cacao research, involving the application of systemic insecticides, the uptake of nutritients and the effect of shade.

60 Ehrhardt, P., Lamb, K.P. VERSUCHE ZUR AUFNAHME UND EXKRETION VON JOD-131 BEI Aphis fabae S. Scop. (APHIDAE, HOMOPTERA, INSECTA). (Experiments on the absorption and excretion of ^{131}I by Aphis fabae Scop. (Aphidae, Homoptera, Insecta).) Int. J. appl. Radiat. Isotopes 18, 7 (1967) 543-544. (In German)

The absorption of ^{131}I (in the form of NaI in thiosulfate and carrier-free aqueous solution, specific activity 2.8 mCi/ml) was studied in larvae and adults. At the start of feeding ^{131}I accumulates in the insect and is not excreted as rapidly as other tracers: it is excreted 4-5 d later when no further I is stored by the organism. ^{131}I may also be given via Vicia faba leaves, and again it takes 4-5 d to reach maximum activity. The tracer is evenly distributed in the phloem. ^{131}I is excreted via honeydew, in only small amounts to begin with, and in considerable quantity by adults via larvae. Except for marked losses of radioactivity (from 14.6 - 39.6%) through moulting, presumably by 1-incorporation into cuticle proteins, larvae show only slight losses (e.g. from 1304 counts/100 s to 1275 counts/100 s in 48 h). Losses via the saliva are unimportant quantitatively. The incorporation of ^{131}I appears to be relatively uniform, except for the cuticle.

61 Eldefrawi, M.E., O'Brien, R.D. PERMEABILITY OF THE ABDOMINAL NERVE CORD OF THE AMERICAN COCKROACH, Periplaneta americana (L.) TO QUATERNARY AMMONIUM SALTS. J. exp. Biol. 46, 1 (1967) 1-12.

The influx and efflux of two series of tritiated quaternary alkylammonium cations in the abdominal nerve cord have been studied. Series I had the general structure $RN^+(CH_3)_3I^-$, where R = C_2H_5, C_4H_9, C_6H_{13}, C_8H_{17} and $C_{10}H_{21}$. Series II had the general structure $C_2H_5N^+(R')_3I^-$, where R' = CH_3, C_2H_5, C_3H_7, C_4H_9 and C_5H_{11}. The data are interpreted as showing that increasing liposolubility tends to increase penetration, and increasing size (with respect to the smallest cross-sectional area) decreases it. The influx rates of the quaternary alkylammonium cations into the cockroach central nervous system (CNS) is 2-7 times lower than Na^+ when equimolar concentrations are compared. Acetylcholine penetrates into the CNS rapidly due to its metabolism, since in the presence of eserine its influx rate becomes similar to that of the analogous alkylammonium cation which is unmetabolized. The alkylammonium cations that penetrate into the CNS appear to be distributed into fast and slow pools, as judged by their relative rates of efflux. These may represent the distribution of cations between extracellular and intracellular spaces or possibly free and bound cations in the extracellular spaces. Although the alkylammonium cations penetrate the CNS, they apparently encounter a regulatory system that discriminates against large size, positive charge and polarity.

OMISSION. Reference should here be made to 464 and 465, erroneously listed in the wrong context.

464 Espinola, H.N., Capuñay, R., Silva, J.E., da. EFFECTIVE HALF-LIFE OF ^{32}P IN THE SANDFLY Lutzomyia longipalpis (Lutz AND Neiva, 1912) (DIPTERA PSYCHODIDAE). Revta bras. Biol. 26 (1966) 175-179.

465 Fairbanks, L.D., Burch, G.E. TURNOVER OF RADIOSODIUM IN Drosophila melanogaster ADULTS OF DIFFERENT AGES. J. Insect Physiol. 12 (1966) 591-599.

62 Getsova, A.E., Volkova, G.A. NEW DATA ON THE ACCUMULATION OF ^{35}S AND ^{106}Ru BY LARVAE OF DRAGONFLIES. Ent. Obozr. 46, 1 (1967) 68-69. (In Russian)

The accumulation of ^{35}S and ^{106}Ru in larvae of dragonflies (Aeschna grandis) decreases with an increase of physiolog. age. (CA 67: 1967, 30098p)

63 Grosch, D.S. DISTRIBUTION AND EFFECTIVE HALF-LIFE OF COBALT-58 IN Habrobracon. Nature, Lond. 208 (1965) 906-907.

Young Bracon hebetor females were fed a single meal from a mixture containing 100 μCi of carrier-free $^{58}CoSO_4$/ml of saturated sugar water. The average wasp weighing 1.32 mg ingested ~ 0.5 μCi of ^{58}Co. The radioactivity of each of a sample of 31 wasps was determined daily until death, using a conventional scintillation, well counter connected to an integrating decade scaler. The eggs deposited were collected daily and hatchability determined after 48 h. From other samples, the radioactivity for the whole body, for the anterior and the posterior parts transsected at the petiole, the gut, the fat body with urates and the genital system obtained by dissection was determined (usually three counts/specimen). The average life span of wasps fed ^{58}Co compared well with controls (25.6±3.1 d against 26.4±2.0 d). The effective half-life was attained by the 3rd-d following a ^{58}Co-meal. During this period most of ^{58}Co was abdominal, falling from 98% in the first 2 h through 94% at the end of the 1st-d to 90% on the 3rd-d. Even after 20 d, 89% of the ^{58}Co-burden was abdominal. The level of the gut and its contents paralleled that of the abdomen. Neither ovaries nor eggs became appreciably radioactive. Hatchability was low only on the 1st-d (76%), rising to 98% on the 2nd-d. - Investigations of the bioaccumulation of isotopes of the transition elements appear essential for an understanding of potential environmental hazards.

64 Harvey, W.R., Nedergaard, S. SODIUM-INDEPENDENT ACTIVE TRANSPORT OF POTASSIUM IN THE ISOLATED MIDGUT OF THE Cecropia SILKWORM. Proc. natn. Acad. Sci. U.S.A. 51 (1964) 757-765.

The lumen of an isolated larval midgut is 84 mV positive to the blood side. K diffusion potentials contribute to but do not account for the trans-midgut potential. The ^{42}K flux toward the lumen is 32 times greater than predicted from the electrochemical potential. At least 87% of the short-circuit current is carried by K moving towards the lumen. Apparently, Na plays no role in this active K transport since similar potential differences, short-circuit currents, and K fluxes are obtained with or without Na. (Auth.summary)

65 Harvey, W.R., Haskell, J.A., Zerahn, K. ACTIVE TRANSPORT OF POTASSIUM AND OXYGEN CONSUMPTION IN THE ISOLATED MIDGUT OF Hyalophora cecropia. J. exp. Biol. 46, 2 (1967) 235-248.

Flux measurements with ^{42}K reveal that in the isolated midgut of H. cecropia 90 - 100% of the short-circuit current is carried by the active transport of K from the blood-side to the lumen. When K-transport is strongly depressed, either by withholding K from the blood side or by imposing a large positive potential on the lumen, the O-uptake of the isolated gut remains virtually unchanged. If the K-transport were to be energized by the negligible increase in oxygen uptake about 40 μ-equivalent of K would have to be transported for every μ-equivalent of extra oxygen taken up. This ratio of K-transport to O-uptake is thermodynamically impossible. The ratio of K-transported to total O consumed when the midgut is bathed with 32 mM K on both sides is about 1.3 at temperatures of 25 and 15°C. The ratio must be smaller at lower K concentrations and is 2.0 at 73.5 mM-K, which may be approaching the max. value. Although the O-uptake is independent of the K-transport, the reverse is not true. There is a close dependency of K-transport on oxygen consumption. K-transport by the midgut contrasts with Na-transport by the frog skin because Na-transport stimulates oxidative metabolism whereas K-transport does not. Evidently the coupling of transport to energy supply is different in the two systems. (Auth.)

66 Haskell, J.A. Clemons, R.D., Harvey, W.R. ACTIVE TRANSPORT BY THE Cecropia MIDGUT. I. INHIBITORS, STIMULANTS, AND POTASSIUM-TRANSPORT. J. cell. comp. Physiol. 65 (1965) 45-56.

Harvey and Nedergaard (see ref. 64) have shown the midguts isolated from mature larvae of the Cecropia silkworm, when perfused in aerated, agitated physiological solution, exhibit a large electrical potential with the lumen-side positive to the blood-side. Isotope studies* show that potassium carries 83% of the current generated by the midgut when the potential is short-circuited. These and other data demonstrate that potassium is actively transported from blood-side to lumen-side of the midgut epithelium. Neither the potential nor the current requires sodium. The effects of various chemicals on this Na-independent active transport of K were examined. The short-circuit current

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* ^{42}K

was rapidly and reversibly inhibited by anoxia and 2,4-dinitrophenol. An irreversible inhibition was effected by iodoacetate. No observable change was produced by cholinesterase inhibitors, adrenalin, pituitary hormones or small changes in pH. Ouabain, a cardiac glycoside which is thought to be a specific inhibitor of sodium transport, was without effect at concentrations as high as 10^{-4} M. Barely affected by 5% CO_2, the current was strongly and reversibly depressed by 25% CO_2. The carbonic anhydrase inhibitor hygroton at 10^{-3} M was without effect but the related sulfonamide cardrase caused 36% inhibition at this concentration. The sulfonamides are barely soluble in water and perhaps penetrate the midgut cells with difficulty. Another type of carbonic anhydrase inhibitor, sodium sulfide, caused reversible inhibitions of 31% at 10^{-4} M and 87% at 10^{-3} M respectively. Clearly the K transporting system of Hyalophora cecropia has important differences from Na systems, and possibly employs a K, H ion-linked pump. (Auth.)

67 Hungate, F.P. RESPONSE OF INSECTS TO RADIATION. p.1 of "Pacific Northwest Laboratory Monthly Activities Report, April 1966, on AEC Division of Biology and Medicine Programs". BNWL-257, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. May 1966, 18p.

In a preliminary study to investigate the pathways of insecticides (distribution, concentration, translocation) in the flour beetle, ^{131}I was injected orally. After an (?) interval assumed sufficient for distribution ~50% of the injected ^{131}I was found in the thorax rather than in the abdomen as expected.

68 Jones, T.H. THE UPTAKE OF STRONTIUM 90 BY Chironomus varus. Entomologist 100 (1967) 2.

It was observed that 20 out of 30 dissected snails, Limnaea peregeri (Mull), contained larval stages of Chironomus (Parachironomus) varus in the mantle cavity. The Ca ion concentration of the Shropshire Union Canal where they were found was 66 ppm Ca^{++} and the pH was 7.4. The radioactivity was expressed as an Accumulation Factor (AF), based on the fresh weight of the organism.

$$AF = \frac{\text{cpm of larva}}{\text{fresh weight in g}} \times \frac{\text{volume of liquid taken}}{\text{cpm of liquid}}$$

The larvae concentrated ^{90}Sr (AF of 5 at 5 d) and since these larvae form the diet of other aquatic organisms there is a possibility of further contamination in the food chain. Since ^{90}Sr has a half-life of 28 y it would have a long term effect on other organisms, with possible genetic effects.

69 Kallay, N., Tigyi-Sebes, A. LOCALIZATION OF $^{32}PO_4^{3-}$ IN ISOLATED MUSCLE FIBRIL. Acta biochim. biophys. 2, 2 (1967) 221-224.

Bees were fed labelled Na_2HPO_4 and the thorax muscle examined for ^{32}P uptake. Approximately 75% of the activity was found in the A-band of the fibril, 17% in the Z-line, and the remainder in the I-band. (CA 67: 1967, 106283t)

70 Lahiri, S.K., Roy, A., Banerjee, D., Jamdar, S.C., Basu, S.R., Nag, B.D. IONIC DISTRIBUTION STUDIES IN HEMOLYMPH FROM DIFFERENT PARTS OF Periplaneta americana BY RADIOACTIVE TRACERS. Indian J. exp. Biol. 5, 1 (1967) 27-28.

Adult cockroaches were injected with carrier-free $^{24}NaCl$, $H^{36}Cl$, $Na^{131}I$, and $Na_2H^{32}PO_4$ in aqueous solutions and $^{59}FeCl_3$ in HCl between the 3rd and 4th-somite of the abdomen. The radioactivity was measured at regular intervals in the haemolymph collected from the antenna and femur of each insect. In general, the femoral haemolymph was richer in inorganic cation and poorer in anion than the antennal haemolymph. The concentrations of Na^+, Cl^-, HPO_4^{2-}, and I^- differed in the antennal and femoral haemolymphs, while the concentration of Fe^{3+} was the same in the 2 haemolymphs. The antennal haemolymph had larger amounts of Na^+ and I^- and lesser amounts of Cl^- and HPO_4^{2-} than the femoral haemolymph. The internal radiation had no effect on the relative ion distribution in the antennal and femoral haemolymph, even when heavy doses, i.e. up to 100 μCi of the isotope was administered to each insect. (CA 67: 1967, 30184x)

71 Lezzi, M., Kroeger, H. AUFNAHME VON ^{22}Na IN DIE ZELLKERNE DER SPEICHELDRÜSEN VON Chironomus thummi. (The uptake of ^{22}Na into cell nuclei of salivary glands of Chironomus thummi.) Z. Naturf. 21b, 3 (1966) 274-8 (In German with English abstract)

The in vivo and in vitro uptake of ^{22}Na from the haemolymph into cell nuclei of larval salivary glands was measured and compared. The uptake of ^{22}Na in vivo follows approximately a saturation

curve. The respective in vitro curve has a much steeper slope during the first 8 min and this phase is followed by an interval during which the ^{22}Na content of the nuclei decreases (8 - 16 min). After the 16th-min it increases again to reach a nuclear ^{22}Na content approximately twice as high as that of nuclei in vivo at 60 min. The uptake curves are discussed in relation to recent findings on the induction of puffs in polytene chromosomes by inorganic ions. (Auth.)

72 Lezzi, M. SPEZIFISCHE AKTIVITÄTSSTEIGERUNG EINES BALBIANIRINGES DURCH Mg^{2+} IN ISOLIERTEN ZELLKERNEN VON Chironomus. (Specific activity increase in a Balbiani ring in isolated cell nuclei of Chironomus by means of Mg^{2+}.) Chromosoma 21, 1 (1967) 109-122. (In German, with English abstract)

Mg^{2+} induces in isolated salivary gland nuclei of C. thummi and C. tentans a specific enlargement of one Balbiani ring, whereas Na^{+} or K^{+} do not. Incorporation of ^{3}H-uridine suggests that this specific enlargement is a sign of increased RNA synthesis of this chromosome region. Based on recent studies on the structure and function of Balbiani rings a model is proposed to explain the mechanism by which Mg^{2+} differentially influences chromosomal RNA synthesis. (Auth.)

73 Moulder, B.C. ECOLOGICAL STUDIES OF FOREST FLOOR SPIDER POPULATIONS. Paper presented at the "American Institute of Biological Sciences Meeting. College Station, Tex., Aug. 1967".

Measurements of radiocaesium turnover and oxygen consumption were made on ^{134}Cs tagged spiders as part of a radiotracer study to measure the energy balance of forest floor spider populations. Various lycosids (Lycosa punctualata, Pardosa sp., and Schizocosa sp.) and gnaphosids (Gnaphosa fontinalis and Drassyllus virginiamus)were used in the experiments. A body size relationship occurred with both radiocaesium turnover and oxygen consumption, with larger individuals tending to have longer biological half-lives for ^{134}Cs and lower O_2 consumption rates. Measurements made at three temperatures (15, 20, and 25°C) showed an increase in metabolic activity with higher temperatures, reflected by shorter mean biological half-lives and higher mean respiratory rates. Number and biomass estimates, obtained by bi-weekly collections of 0.1 m^2 and 1 m^2 litter samples, indicate the importance of spiders as predators in the forest cryptozoan community. Data on radiocaesium elimination rates and equilibrium values in the field, respiratory rates, number and biomass estimates, and calorific equivalents will be used to calculate the energy budget for this major group of forest floor predators. (Abstr.)

74 Oftedal, P. A STUDY OF THE RETENTION AND THE MUTAGENIC MODE OF ACTION OF RADIOACTIVE PHOSPHORUS IN Drosophila melanogaster. Hereditas 40 (1959) 245-331.

The genetic effects of ^{32}P on different stocks of D. melanogaster were examined. ^{32}P was added to standard medium when raising males. Only few experiments were conducted with ^{91}Y. Some data were obtained on the part played by ^{32}P and ^{91}Y in metabolism, their incorporation into sperm, and their mutagenic effects especially in the rate of induction of lethals.

75 Oftedal, P., Kaplan, W.D. SOME ASPECTS OF TRANSMUTATION STUDIES IN Drosophila. "Biological Effects of Decay of Incorporated Radioisotopes, Panel Meeting. Vienna, Austria, 9-13 Oct. 1967".

76 Patterson, R.S., Smittle, B.J., Lofgren, C.S. DISTRIBUTION OF ^{32}P IN THE MALE REPRODUCTIVE SYSTEM OF Culex pipiens quinquefasciatus (Say). Bull. ent. Soc. Am. 13, 3 (1967) 201. Abstr.317 "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

4th-instar male larvae of Culex p. quinquefasciatus exposed for 48 h to ^{32}P at the rate of 0.25 µCi/ml/larva accumulate enough radioactivity so that they can transfer a detectable amount to females during insemination. The radioactivity is found in both the sperm and the accessory gland fluid. (Abstr.)

77 Plummer, G.L. BIOACCUMULATION OF RADIONUCLIDES ON GRANITIC OUTCROPS IN THE GEORGIA PIEDMONT. Final Report. NP-16464, Georgia Univ., Athens. Oct. 1966. 68p.

A 5 yr study of the accumulation of radioisotopes by plants and animals inhabiting the granitic outcrop ecosystems of the Georgia Piedmont was conducted beginning in 1961. Natural and fallout radioactivity was investigated by assaying the granites, soils, some plants, insects, and animals for quantities of radioisotopes. Attempts were made to explain actions and interactions between various radioisotopes, soils, plants, water-flow through communities and concentrations within components of the respective

ecosystems. ^{137}Cs, ^{90}Sr, and ^{54}Mn concentrations were of the greatest interest and data on their uptake by plants, insects, and deer are detailed. (NSA 21: 1967, 19759)

78 Quraishi, M.S., Brust, R.A., Lefkovitch, L.P. UPTAKE, TRANSFER, AND LOSS OF ^{32}P DURING METAMORPHOSIS, MATING, AND OVIPOSITION IN Aedes vexans. J. econ. Ent. 59, 6 (1966) 1331-1333.

The uptake of ^{32}P as a function of time per unit dry weight of A. vexans (Meigen) larvae has been studied. There was a significant uptake of ^{32}P by instar IV larvae up to 72 h, although the rate of uptake was very rapid during the first 24 h. There was little, but measurable, transfer of radioactivity from radioactive males during induced copulation. The radioactive female deposited appreciable radioactivity with the eggs. (Auth.)

79 Reichle, D.E. THE BEHAVIOUR OF RADIOCESIUM DURING INSECT METAMOPHORSIS. ASB Bull. 13, 2 (1966) 44. Abstr.

The evergreen bagworm, Thyridopteryx ephemeraeformis, was employed as a model for the uptake and fate of ^{134}Cs during transformation in insect populations feeding upon contaminated vegetation. Pupating female larvae were placed in artificial cases simulating natural bagworm cases in which normal development occurs (38 d), and reared to adults at mean field temperatures of 72°F (40 d). Essentially the entire radiocaesium body burden was transferred from the larval to pupal stage, with only 0.3% lost with the cast skin at ecdysis. The activity density in the pupa increased by about 16% over the larval stage. Expressed as a percentage of pupal radioactivity the distribution was: 10% to puparium and miscellaneous residues, 40% to egg clutch, and 50% remaining with the female after oviposition. Slightly less than half the female body burden of radiocaesium (44.5%) was transferred in egg production, which in itself accounted for 82.4% of the total female biomass. (Abstr.)

80 Reichle, D.E. MEASUREMENT OF ELEMENTAL ASSIMILATION BY ARTHROPODS. Bull. ecol. Soc. Am. 48, 2 (1967) 64. Abstr.

Measurements of nutrient assimilation by animals from dietary inputs often are based upon analyses of chemical contents of food and faeces. Assimilation measurements based upon faecal concentrations, however, are biased by the organism's turnover of materials through normal excretory and secretory processes. Developments in radioisotope tracer methodology provide means for estimating nutrient absorption from food. Animals fed upon radioisotope tagged food acquire body burdens of isotope (Q) which decrease as $dQ/dt = -kQ$. For many organisms, the turnover rate of isotope (k) consists of a two-component system with two interacting rate coefficients (k_1 and k_2). The coefficient k_1 represents turnover of non-assimilated isotope in food in the gut, and k_2 the turnover of assimilated isotope in body tissues. Graphical analyses of retention curves and separation of rate coefficients, permit estimation of percent of whole-body radioactivity (Q) lost at each rate. For single feedings of isotope, these percentages may be related to the fraction of Q in body tissue (q_2) and that remaining with undigested food (q_1). Element assimilation and q_2, under these conditions, are equivalent. (Abstr.)

81 Shyamala, M.B., Bhat, J.V. MINERAL ASSIMILATION IN THE SILKWORM Bombyx mori L. Indian J. exp. Biol. 4, 1 (1966) 31-34.

82 Stobbart, R.H. THE EFFECT OF SOME ANIONS AND CATIONS UPON THE FLUXES AND NET UPTAKE OF CHLORIDE IN THE LARVA OF Aedes aegypti (L.), AND THE NATURE OF THE UPTAKE MECHANISMS FOR SODIUM AND CHLORIDE. J. expl. Biol. 47, 1 (1967) 35-57.

Measurements of fluxes were carried out on chloride influx alone, chloride outflux alone, simultaneous measurement of sodium and chloride influx, and simultaneous outflux of sodium and chloride. Instead of the short-lived ^{24}Na the isotopes ^{22}Na and ^{36}Cl were used (see III/42 for details of method). The anal papillae of the aquatic larva of A. aegypti are responsible for 90% of the steady-state exchange of chloride. The relationships between chloride flux and external chloride concentration are approximately described by the Michaelis equation. There is net-uptake of chloride, independent of uptake of sodium, from KCl, $CaCl_2$ and NH_4Cl, probably in exchange for OH^- or HCO_3^-, but the rate is much slower than from NaCl. The following ions stimulate influx of chloride from 0.1 mM/l.: KCl; $H^+ = Na^+ > K^+$. The following ions inhibit it: $OH^- > HCO_3^- > NO_3^-$. Movements of sodium and chloride ions are explicable in terms of an anionic and a cationic carrier located in an osmotic barrier in the papillae, the carriers being functionally coupled to sodium and chloride pumps located at the inner

surface of the barrier. An attempt is made to relate these findings to recent electron microscopical studies of the papillae.

83 Timofeeva-Resovskaya, E.A., Getsova, A.B., Timofeev-Resovskii, N.V. EFFECT OF EDTA ON COEFFICIENTS OF ACCUMULATION OF VARIOUS RADIOISOTOPES FROM WATER SOLUTION BY SWEET-WATER HYDROBIONTS. Trudy Inst. Biol., Sverdlovsk (1965) 47-61. (In Russian)

The effects of EDTA on the coefficients of accumulation of ^{35}S, ^{59}Fe, ^{60}Co, ^{65}Zn, ^{90}Sr, ^{91}Y, ^{95}Zr, ^{95}Nb, ^{106}Ru, ^{137}Cs, and ^{144}Ce by the sweet-water plants, Elodea canadensis, Ceratophyllum demersum, Lemna minor, Chara fragilis, and leeches Herpodella and larvae of Culex pipiens were studied in 3-litre glass vessels with lake water, with or without sand bottom. EDTA was added at 400 mg/litre, radioisotopes in concentrations corresponding to 1000 disintegrations/min/litre of water. Samples were taken after 2, 4, 8, and 16 d; water samples were evaporated, plants and leeches weighed, dried to constant weight, and pulverized. The presence of EDTA did not affect coefficients of accumulation of S by plants, leeches and mosquitoes, increased those for Sr and Cs (except for Cs accumulation by mosquitoes), decreased a little those for Zr, Nb, and Ru, and considerably those for Fe, Co, Zn, Y, and Ce. All four kinds of plants, as well as leeches and mosquitoes, gave practically the same results, with negligible differences in accumulation coefficients. (CA 65: 1966, 5826d)

84 Toppozada, A., O'Brien, R.D. PERMEABILITY OF THE GANGLIA OF THE WILLOW APHID, Tuberolachnus salignus, TO ORGANIC IONS. J. Insect Physiol. 13 (1967) 941-954.

A technique was developed that made possible the study of influx of compounds into the ganglia of the willow aphid. Penetration of ^{14}C fatty acids into the aphid ganglia was biphasic, and increased with increasing liposolubility from acetate to valerate, but influx of hexanoate and heptanoate was similar to that of valerate. The influx rate of acetate into the aphid ganglia was almos twice that into the American cockroach abdominal nerve cord, but influx of valerate was similar in both species. Increasing liposolubility resulted in a greater increase in influx in the case of the cockroach than the aphid. The influx of ^{3}H-quaternary ammonium cations into the aphid ganglia was similar but slightly smaller than influx into the cockroach nerve cord. The kinetics were biphasic, differing in this way from the case of the cockroach. Increasing liposolubility tended to increase penetration, and increasing size, with respect to the smallest cross-sectional area, tended to decrease it. Metabolism of the organic ions in the aphid ganglia increased influx rate, as shown by studies on influx of acetylcholine alone and in the presence of eserine, and valerate alone and in the presence of DNP. The rate of penetration into the aphid ganglia was much higher for the fatty acids than the quaternary ammonium compounds. There seems to exist in the aphid ganglia a 'regulatory system' that restricts influx, especially of large, polar, and unmetabolisable cations. (Auth.)

85 Treherne, J.E. THE EFFECT OF OUABAIN ON THE EFFLUX OF SODIUM IONS IN THE NERVE CORDS OF TWO INSECT SPECIES (Periplaneta americana AND Carausius morosus). J. exp. Biol. 44 (1966) 355-362.

The intracellular efflux of ^{22}Na from the nerve cord is reduced by the presence of ouabain in the bathing medium. With Periplaneta 10^{-4}M ouabain caused a reduction in the rate constant for sodium efflux from 3.94×10^{-3} sec^{-1} to 1.80×10^{-3} sec^{-1} and in Carausius from 1.14×10^{-3} sec^{-1} to 6.18×10^{-4} sec^{-1}. Uncoupling of the energy supply to the sodium pump, by the addition of cyanide, did not further reduce the sodium efflux from ouabain-treated axons, suggesting that the greater part of the active extrusion of this cation is effected by a single ouabain-sensitive carrier mechanism. The relative insensivity to ouabain of the insect axons, as compared with squid giant axons, is shown to result from the presence of a rather leaky axon membrane in which the carrier-mediated component forms a much smaller part of the total flux. The concentration gradient of sodium across the insect axon membrane is related to the combined effects of the activity of the sodium pump and the passive permeability of the membrane. (Auth. summary)

See also:

205 The effect of different ions on the incorporation of (U-^{14}C) valine into fat body protein of the larva of the blowfly, Calliphora erythrocephala. (Price, G.M.)

314 Incorporation of radioactive uridine into the RNA of the lepidopteran, Barathra brassicae. (Morris, O.N., 1966)

443 Health in uranium mining. (Anonymous, 1964)

496 Pacific northwest laboratory monthly activities report, October 1966, on AEC division of biology and medicine programs. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab., 1966)

507 Radiation ecology, (Auerbach, S.I., 1967)

515 ^{106}Ru elimination by brown crickets (Acheta domesticus). (Crossley, D.A., Jr., 1966)

516 Comparative movement of ^{106}Ru, ^{60}Co, and ^{137}Cs in arthropod food chains. (Crossley, D.A., Jr., 1967)

518 Etude de la contamination externe de l'abeille et de son milieu par un radio-isotope introduit dans la nourriture. (Douault, P., 1966)

519 Amélioration d'une technique de recherche de la contamination de l'abeille marquée au moyen d'un radio-isotope. (Douault, P., 1966)

521 Review and discussion of barium. (French, N.R., 1963)

522 Accumulation of individual radioisotopes by different aquatic insects. (Getsova, A.B. et al., 1964)

523 Bacterial transport of radiophosphorus in a stream ecosystem. (Hooper, F.F. et al., 1966)

525 A radionuclide tracer study of arthropod food chains in a Spartina salt marsh ecosystem. (Marples, T.G., 1965)

529 Radioecology of the Colorado range. (Osburn, W.S., Jr., 1964)

530 Rates and pattern of radioisotope release from fresh tree litter at three levels of mesic forest development. (Petty, R.O. et al., 1965)

531 Investigation of ^{32}P-uptake and clearance in some brackish organisms of the Agigea and the Eforie Lakes. (Pora, E. et al., 1965).

533 Trophic level concentrations of Cs-137, sodium, and potassium in forest arthropods. (Reichle, D.W. et al., 1965)

535 Possibility of contamination of insectivorus game birds during ecological investigations using insects labelled with ^{60}Co. (Wegorek, W. et al., 1963)

536 Remarques sur l'incorporation de ^{35}S par une grégarine intestinale d'insecte orthoptère. (Corbel, J.C., 1965)

543 Efficiency of radioisotope transfer in predator-prey systems. (Crossley, D.A., Jr. et al., 1966)

544 Radioactive tracer measurements of predation by arthropods. (Crossley, D.A., Jr., 1967)

548 Radioisotope measurement of food consumption by a leaf beetle species, Chrysomela knabi Brown. (Crossley, D.A., Jr., 1966)

553 Rates and pattern of radioisotope release from fresh tree litter at three levels of mesic forest development. (Petty, R.O. et al., 1965)

638 Insecticide mode of action. Effect of dieldrin on ion movement in the nervous system of Periplaneta americana and Blattella germanica cockroaches. (Hayashi, M. et al., 1967)

659 Interactions of DDT with components of American cockroach nerve. (Matsumura, F. et al., 1966)

1.2.3. Carbohydrates.

86 Bricteux-Grégoire, S., Jeuniaux, C., Florkin, M. BIOCHEMISTRY OF THE SILKWORM. XXX. BIOSYNTHESIS OF TREHALOSE AND GLYCOGEN FROM GLUCOSE 1-PHOSPHATE. Comp. Biochem. Physiol. 16, 4 (1965) 333-340.

Glucose 1-phosphate (I) was injected inro 5th-instar silkworm (Bombyx mori) larvae, which were either well fed or poorly fed. Adipose tissue and haemolymph analysis 4 h later showed that fat body glycogen (II) synthesis proceeded more rapidly in the poorly fed larvae. I was used principally for haemolymph trehalose (III) synthesis; the turnover of haemolymph II was similar during both nutritional states. Adipose tissue II and III were poorly labelled with 0.28-0.62% and 0.03-0.14% incorporation respectively, compared with 12-15% radioactivity incorporation in haemolymph III. III could probably be synthesised from pyruvate in locations other than the fat body, and the biosynthetic III pathway does not necessarily pass through II. III and II syntheses, and II hydrolysis could be controlled, directly or indirectly, by the variation of the haemolymph III levels. When haemolymph III level was increased, as in well-fed larvae, II synthesis occurred, whereas during malnutrition, when III levels decreased, III was synthesised.

87 Chefurka, W. ESTIMATION OF PATHWAYS OF CARBOHYDRATE METABOLISM IN INSECTS. Proc. ent. Soc. Ont. 96 (1965) 17-23. Presented at the "102nd Annual Meeting of the Entomological Society of Ontario, London, England. 8 Sep.1965.

Two approaches have been used: (1) the radiorespirometric method which monitors the yield of $^{14}CO_2$ from variously labelled glucose molecules. The pattern of release of $^{14}CO_2$ with time permits certain conclusions as to the nature of the pathways involved, the yields and evaluation of the extent of participation of these pathways. A continuous time-course record of metabolic events is obtained. (2) the Katz and Wood method, based on the fact that the pentose cycle randomizes the ^{14}C between carbons-1, and -3 of glucose-6-phosphate or its derivative, glycogen, when glycogen-2-^{14}C is metabolised. The extent of the randomization is obtained from the radioactivity of carbon-1 and -3 relative to that of -2 in glucose residues of hydrolysed glycogen. In intact Periplaneta americana and Oncopeltus fasciatus 13-17% of the glucose is catabolysed by the pentose cycle, the bulk of it being dissimilated by the glycolysis-tricarboxylic acid cycle. Very little difference in activity of this pathway was noted between the sexes of Oncopeltus and Melanoplus bivittatus, but a striking sexual difference was noted for Periplaneta where the pentose cycle was more active in the male. The pentose cycle evidently plays a much more prominent role in glucose metabolism in Melanoplus than in the other two species. The occurrence of the pentose cycle is accentuated in the presence of inhibitors of glycolysis and/or the tricarboxylic cycle.

88 Chefurka, W. INTERMEDIARY METABOLISM OF CARBOHYDRATES IN INSECTS. p.581-667 of "The Physiology of Insecta, Vol.2". Rockstein, M., Ed. New York, Academic Press Inc. 1965.

This review is broken down into sections on the degradation of polysaccharides and oligosaccharides to monosaccharides (subdivided into carbohydrates, transglycosidases, and phosphorylases); the synthesis of polysaccharides and oligosaccharides from monosaccharides (particularly the synthesis of glycogen and trehalose); the fermentation and oxidation of carbohydrates (subdivided into glycolysis, the citric acid cycle, the electron transport system, oxidative phosphorylation, and the pentose phosphate cycle); the in vivo significance of metabolic routes in insects; and the regulation of metabolisms (in terms of enzymic and hormonal regulation). An extensive bibliography is attached containing numerous references to studies in which radioisotopes had been used.

89 Cheldelin, V.H. POSSIBLE METABOLIC CONTROL MECHANISMS IN THE PENTOSE PHOSPHATE OXIDATION PATHWAY. Proc. Robert A. Welch. Found. Conf. Chem. Res. 5 (1961) 281-285.

For Acetobacter suboxydans, fructose 1,6-diphosphate is hydrolysed to fructose 6-phosphate in the presence of Mg^{2+} and diphosphothiamine (I). For chick, hog, or beef embryos, and also for successive developmental forms of blowflies, the ratio of yields of $^{14}CO_2$ from glucose-1-^{14}C and from glucose-6-^{14}C are initially high but decrease with increasing age. Control of pentose oxidation versus glycolysis may lie in cell concentration of NADP or of I and Mg^{2+}. (CA)

90 Clements, A.N., Grace, T.D.C. THE UTILIZATION OF SUGARS BY INSECT CELLS IN CULTURE. J. Insect Physiol. 13, 9 (1967) 1327-1332.

D-glucose-^{14}C (3.57 mCi/mM) was used to prepare radioactive trehalose biosynthetically. Cells of Antheraea eucalypti Scott (Lepidotpera: Saturniidae) in culture utilize trehalose at approximately the same rate as glucose. Sucrose (sucrose-^{14}C was used, at 22.8 mCi/mM) is not utilized during the first days of a subculture, and its subsequent utilization coincides with a fall in glucose concentration.

91 Courtois, J.E., Percheron, F., Guilloux, E. PURIFICATION ET ETUDE DE LA SPECIFICITE DE LA TREHALOSE DU HANNETON (Melonotha vulgaris). C.r. hebd. Séanc. Acad. Sci. 265, 25D (1967) 2111-2114.

Les auteurs décrivent la purification de la tréhalase extraite du Hanneton, et indiquent les propriétés de cette osidase. En effectuant une hydrolyse du tréhalose en présence de glucose marqué au ^{14}C, les auteurs n'ont pu mettre en évidence aucune incorporation de glucose radioactif dans le tréhalose. L'absence d'hydrolyse de dérivés substitués non symétriques du tréhalose montre que les hydroxyles en position 3 et 6 des deux unités glucosyle du tréhalose doivent être libres pour que l'action hyrdolysante de l'enzyme se manifeste. De nombreux composés intermédiaires du métabolisme glucidique sont dépourvus de pouvoir inhibiteur, et cette tréhalase est dépourvue d'activité transférante.

92 Engels, W., Bier, K. GLYKOGENSPEICHERUNG WÄHREND DER OOGENESE UND IHRER VORZEITIGEN AUSLÖSUNG DURCH BLOCKIERUNG DER RNS-VERSORGUNG (UNTERSUCHUNGEN AN Musca domestica L.) (Glycogen accumulation during oogenesis and its premature release by blocking of the RNA supply. (Study on Musca domestica L.).) Wilhelm Roux Arch. Entw Mech. 158, 1 (1967) 64-88. (In German, with English summary)

^{3}H-uridine, -histidine, -leucine, -lysine, and ^{3}H-valine were used. In the oocyte of the house fly, M. domestica L., glycogen is stored for the time at an advanced developmental stage (stage 5 of the classification used). Initial glycogen deposition is marked by a follicle epithelium serrated towards the ooplasm and by the degeneration of the trophocytes. During glycogen synthesis, the oocyte is no longer supplied with RNA, and the incorporation of amino acids declines. At the same time, with the formation of the chorion most of the glycogen grana are deposited into the reticuloplasm of the oocyte excluding the periplasm. ^{3}H-glucose is incorporated only during glycogen synthesis. Already after 1 min of incubation, the pattern of labelling corresponds to that of the glycogen granules. Glycogen molecules are therefore concluded to remain at the site of synthesis. In normal development, no glycogen is found in nurse or follicle cells.

93-a Florkin, M., Jeuniaux, C. METABOLISME DU TREHALOSE ET DU GLYCOGENE CHEZ LE VER A SOIE, EN RELATION AVEC LA MUE, LE FILAGE ET LES METAMORPHOSES. Bull. Acad. r. Belg. Cl. Sci. 51, 5 (1965) 541-552. (With English summary)

The principal circulating form of saccharidic cellular food in the silkworm is trehalose. The enzyme trehalase, in the haemolymph, is normally inhibited. Inhibition is only suppressed during moulting, causing a decrease in trehalose concentration and an increase in the amount of free glucose. The muscles and most other tissues, such as the digestive tract, are able to use blood trehalose, thanks to an intracellular trehalase. The epidermis and the silk glands are devoid of trehalase: they use the free glucose liberated by the hydrolysis of the haemolymph trehalase during the periods of moulting and spinning. The problem of the origin of the trehalose is discussed, in the light of recent experiments, in which the incorporation of radioactivity from *labelled pyruvate and glucose-1-phosphate into a fat body glycogen and haemolymph trehalose has been followed. The chitin of the cuticle is synthesised at every moulting process, partly at the expense of the glucose liberated by the hydrolysis of the trehalose in the haemolymph. On the other hand, the old cuticle is destroyed by the proteolytic and chitinolytic enzymes of the exuvial fluid. The hydrolytic products, especially N-acetylglucosamine, are resorbed by the epidermis and can be used for the biosynthesis of the chitin of the new cuticle. (Essentially auth. summary)

* ^{14}C-

93-b Fristrom, J.W. DEVELOPMENTAL AND BIOCHEMICAL STUDIES ON THE MORPHOLOGICAL MUTANT CRYPTOCEPHAL OF Drosophila melanogaster. Diss. Abstr. 27, 10 (1967) 3402-B - 3403-B.

Studies have been conducted on the morphological mutant cryptocephal of D. melanogaster in an attempt to elucidate the mechanism of action of the mutant gene and also to uncover possible mechanisms of suppression of the cryptocephal gene by other genes in the stock. The main developmental abnormality of the cryptocephal mutant is that its head does not evert at the time of pupation. It has been possible to demonstrate that the mutant has greater mechanical resistance to head emergence than the wild type. Experimental evidence indicates that the increased resistance to head emergence is produced by an increase in rigidity of the integument. It has been possible to show that the cryptocephal mutant has more glucosamine (presumably chitin) in its integument at the time of pupation than the wild type. The increased content of glucosamine is presumed to be responsible for the increased rigidity of the integument. Biochemical evidence obtained from studies with glucose-U-^{14}C indicates that the rate of chitin synthesis is higher in the mutant than in the wild type. The phenocopy of the cryptocephal mutant produced by glucosamine was shown to have also an increased content of glucosamine in its integument at pupation and also has increased resistance to head emergence. The common features found between the glucosamine-phenocopy and the cryptocephal mutant offer additional verification to the developmental model presented above for the action of the cryptocephal gene. The modifiers in the cryptocephal stock act by decreasing mechanical resistance to head emergence (and thus allow it) and by decreasing the excess content of glucosamine found in the cryptocephal integument. Cryptocephal stock

could be shown to resist the incorporation of free glucosamine. It is proposed that this resistance is one means by which the modifying genes decrease the content of glucosamine in the integument, and lower the mechanical resistance to head emergence. The relevance of the results to normal genetic activity during development and to the phenocopy concept is discussed. (From DA)

94 Gelperin, A. CONTROL OF CROP EMPTYING IN THE BLOWFLY. J. Insect Physiol. 12, 3 (1966) 331-345.

The control of crop emptying in the blowfly, Phormia regina, was investigated by the technique of x-ray photography. Increasing the osmotic pressure of the solution in the crop slows crop emptying. This effect is independent of the nutritive value, stimulating power, and viscosity of the solution. Increasing the osmotic pressure of the blood also greatly slows crop emptying. Blood osmotic pressure is the controlling factor. The effect of increased blood osmotic pressure in slowing crop emptying is independent of nervous or endocrine elements. The rate of absorption of sugar across the midgut wall was studied using ^{14}C-labelled carbohydrates. Two in vitro midgut preparations were employed. No evidence for active transport was found.

95 Gilby, A.R., Wyatt, S.S., Wyatt, G.R. TREHALASES FROM THE COCKROACH, Blaberus discoidalis: ACTIVATION, SOLUBILIZATION AND PROPERTIES. Acta biochim. polon. 14, 1 (1967) 83-100.

The thoracic muscle of various insects contains an enzyme capable of hydrolysing trehalose. In several cockroaches and a grasshopper the enzyme activity of muscle homogenates is elevated several-fold repeated freezing and thawing, as previously shown for the Cecropia silkmoth. With muscle of several flies, however, such treatment had no effect on trehalase activity. [1, 1^1-^{14}C] Trehalose was prepared by injecting 50 μCi of [1-^{14}C] glucose (0.65 mCi/mM) into each of two mature larvae of Hyalophora cecropia and permitting incorporation for 6 h at 25°C. In the cockroach, B. discoidalis, trehalase activity is concentrated in a microsomal fraction prepared by centrifugation at 105 000 g. Glycosidase activity is then specific for trehalose; it is inhibited strongly by sucrose and weakly by glucose and D-2-glucosamine. In Blaberus muscle microsomal preparations, trehalase activity is enhanced as a result of treatment with several anionic, cationic, and non-ionic detergents, and by incubation with snake venom, as well as by freezing and thawing. Snake venom, either whole or briefly boiled, gave the greatest activation (up to 10-fold). The activated enzyme exhibits maximal activity at pH 6.0; with untreated enzyme, this could not be determined precisely, but appears to be the same. The K_m for trehalose is 3.3 mM for untreated enzyme and 1.7 mM for activated enzyme. Of the detergents, only deoxycholate solubilizes the microsomal trehalase, and aggregation occurs on removal of the detergent. Snake venom yields trehalase in soluble form which gives single peaks on Sephadex G-200 columns and in sucrose gradient centrifugation. The apparent mol. wt from these methods are 80 000 and 63 000, respectively. It is suggested that this discrepancy may be due to bound lipid. B. discoidalis midgut tissue yields a distinct trehalase, which is entirely in the soluble fraction of homogenates and has pH optimum about 5.0 and K_m for trehalose 0.5 mM.

96 Gussin, A.E.S., Wyatt, G.R. SOLUBLE AND MEMBRANE-BOUND TREHALASES IN INSECTS. Proc. natn. Acad. Sci. India 74 (1965) 350.

97 Horie, Y. PATHWAYS OF CARBOHYDRATE METABOLISM IN INSECTS AND ITS REGULATION. Seibitsu Kagaku 17, 2 (1965) 55-63.

A review. Radioisotopes were used in some of the studies cited. (*)

* Original article not available.

98 Kobayashi, M., Kimura, S. ACTION OF ECDYSONE ON THE CONVERSION OF ^{14}C-GLUCOSE IN DAUER PUPA OF THE SILKWORM, Bombyx mori. J. Insect Physiol. 13 (1967) 545-552.

The effect of ecdysone on the incorporation of ^{14}C-glucose in dauer pupa (brain removed) of B. mori was examined. Incorporation was compared in pupae 18 h after injection of ecdysone or water. Cumulative recovery of $^{14}CO_2$ from ^{14}C-glucose was much the same in the ecdysone-injected pupa as in the control, and in both the recovery of $^{14}CO_2$ from 1-^{14}C-glucose was more than that from 6-^{14}C-glucose. Labelled glucose was converted to blood trehalose after ecdysone

injection but to glycogen in the control. This therefore, suggests the possibility that ecdysone affects the relative activities of enzymes at the branching point of the pathways of trehalose and glycogen syntheses in the fat body, so that the pathway of trehalose synthesis is activated. The blood-sugar content of the 60-d-old dauer pupa with or without the injection of ecdysone was about 1.14 mg/ml, which is much lower than in a normal pupa. (Auth.)

99 Kobayashi, M., Kimura, S., Yamazaki, M. ACTION OF INSECT HORMONES ON THE FATE OF ^{14}C-GLUCOSE IN THE DIAPAUSING BRAINLESS PUPA OF Samia cynthia pryeri (LEPIDOPTERA: SATURNIIDAE). Appl. Ent. Zool. 2, 2 (1967) 79-84.

The mode of action of insect hormone and its related substance upon the metabolism of diapausing pupa was studied on the pupa of S. cynthia pryeri. The brain was extirpated from each pupa at the dormant stage. The brainless pupae were kept at 25°C for five weeks prior to use. ^{14}C-glucose (0.1μCi/μg) was injected into the pupae with ecdysone, proteinic brain hormone or cholesterol having brain hormone activity, respectively. 24h following injection, the incorporation of radioactive glucose into carbon dioxide, trehalose, glycogen, crude lipid, and crude protein was measured by several methods, obtaining the following results. All of the substances acted on carbohydrate metabolism in the brainless pupa and promoted the biosynthesis of trehalose. In control insect without hormone or cholesterol injection, however, radioactive glucose was incorporated into glycogen in the fat body and scarcely incorporated into blood trehalose. On the other hand, incorporation of ^{14}C-glucose in crude lipid and crude protein showed a low value, whether insect hormone or cholesterol was injected. It is concluded that insect hormones, ecdysone and brain hormone, are concerned with the carbohydrate metabolism of S. cynthia pryeri. (Essentially auth.)

100 Murphy, T.A., Wyatt, G.R. ENZYMATIC REGULATION OF TREHALOSE AND GLYCOGEN SYNTHESIS IN THE FAT BODY. Nature, Lond. 202 (1964) 1112-1113.

The chief site of trehalose synthesis in insects is the fat body. There is evidence that the pathway is the same as that first described for yeast:

UDP glucose + glucose-6-P → UDP + trehalose-P
(trehalose-P synthetase)

Trehalose-P + H_2O → trehalose + P_i
(trehalose-6-phosphatase)

Fat body also synthesises glycogen by a similar transglucosylation:

UDP glucose + $(\text{glycogen})_n$ → UDP + $(\text{glycogen})_{n+1}$
(glycogen synthetase)

These pathways have been verified in homogenates of fat body of Hyalophora cecropia. Trehalose-P synthetase was detected by measuring incorporation from both glucose-^{14}C-6-P and UDP glucose-^{14}C into trehalose, and by measuring the release of UDP from UDP glucose. The glycogen synthetase is activated by glucose-6-P, but not by glucose-1-P. The trehalose-P synthetase is activated by Mg^{++} and inhibited by trehalose. - The physiological significance of trehalose inhibition was tested in experiments with intact larval fat body in a haemolymph-like medium. In medium without trehalose, the fat body incoporated glucose-^{14}C into trehalose ten times faster than into glycogen. Addition of trehalose at levels approximating those in larval haemolymph (~50 mM) resulted in decreased incorporation into trehalose and increased incorporation into glycogen. Inhibition of trehalose-P synthetase by trehalose would allow the level of UDP glucose to rise, thus increasing glycogen synthesis. Such a mechanism could explain the apparent regulation of blood trehalose-level in insects. The conversion of carbohydrates which follows injury in saturniid pupae may also be explained by these results together with the activation of glycogen phosphoyrylase.

101 Murphy, T.A., Wyatt, G.R. THE ENZYMES OF GLYCOGEN AND TREHALOSE SYNTHESIS IN SILK MOTH FAT BODY. J. biol. Chem. 240 (1965) 1500-1508.

Enzymes which synthesise trehalose and glycogen from uridine diphosphate glucose are present in homogenates of fat body from larvae and pupae of the silkmoth, Hyalophora cecropia. Glycogen synthetase sediments in the 37 000 × g particulate glycogen fraction. It is activated by glucose 6-phosphate and has kinetic properties similar to those of mammalian glycogen synthetase. Trehalose phosphate synthetase, which remains soluble at 137 000 × g, requires glucose 6-phosphate as a substrate and is inhibited by trehalose. Kinetic evidence indicates that trehalose binds to a site separate from the catalytic site, which can be functionally eliminated by treatments which cause mild protein denaturation. With intact fat body, trehalose in the medium inhibits incorpora-

tion of glucose into trehalose and stimulates incorporation into glycogen. This is interpreted on the basis of feedback inhibition of trehalose phosphate synthetase, which is believed to play a role in regulation of blood trehalose in this species. Glucose-1-^{14}C was used. (Essentially auth. summary)

102 Puro, J. MUTATIONAL RESPONSE OF THE PREMEIOTIC GERM-CELL STAGES OF ADULT Drosophila melanogaster MALES TO x-IRRADIATION. Annls zool. fenn. 3, 2 (1966) 99-126.

The mutagenic effect of 3000 R acute x-irradiation on the spermatogenesis of adult D. melanogaster was studied by means of the brood pattern technique. The irradiation brought about a period of low fertility on the 6th-9th day, almost complete sterility occurred on the 8th day. Restoration of fertility took place in two steps, with a secondary decline during the 11th-12th d. Control level was reached on the 13th- or 14th-day. - Recessive 3rd-chromosome lethal mutuations, Y, three translocations and male sterility mutations (probably arising from damage to the Y-chromosome) showed the familiar brood patterns with gradually increasing mutation rates in the first three successive 2 or 3 d broods, corresponding to progressively earlier postmeiotic germ-cell stages at the time of irradiation. (Auth.)

103 Takahashi, S.Y., Ohnishi, E. ENZYMIC SYNTHESIS OF THE GLUCOSIDE OF PROTOCATECHUIC ACID IN THE COCKROACH, Periplaneta americana. (Seikagaku Zasshi 60, 4 (1966) 473-475. (J. Biochem., Tokyo). (In English)

Labelled β-glucosylprotocatechuic acid was formed during incubation of homogenates of fat bodies from the female cockroach, P. americana, with ^{14}C-labelled UDP-glucose and protocatechuic acid. (CA 66 : 1967, 687 v)

104 Villar, E. del, Mosnaim, D. EFFECT OF DDT ON INCORPORATION OF ^{14}C- LABELED GLUCOSE INTO PROTEIN AND SOLUBLE INTERMEDIATES OF NYMPHAL Triatoma infestans. Expl Parasit. 21, 2 (1967) 186-194.

The mechanism for the greater resistance of T. infestans 4th-instar larvae to DDT in comparison with 3rd-instar larvae was investigated. Both developmental stages rapidly incorporated ^{14}C-labelled glucose into protein and several soluble intermediates, but the rate of incorporation was higher in 4th-instar larvae. DDT increased glucose incorporation into total protein, and this increase was paralleled by the amount of protein in 4th-instar larvae. However, this effect was less apparent in 3rd-instar larvae. DDT also significantly increased free proline in 4th-instar larvae. Chromatographic profiles of larval protein indicated the presence of an active Krebs cycle in these insects, which was apparently inhibited by DDT only in third instar larvae. (CA 68 : 1968, 28728 w)

105 Wiens, A.W. ASPECTS OF HORMONAL AND METABOLIC REGULATION OF CARBOHYDRATE METABOLISM IN THE INSECTS Hyalophora cecropia AND Leucophaea maderae. Diss. Abstr. 27 (1967) 2503-B.

Glycogen phosphorylase in cockroach and Cecropia fat body occurs in forms having differential sensitivity to 5'-AMP, is bound to glycogen and is soluble. Phosphorylase activity in cockroach fat body is 4 and 70-fold greater, respectively, than adult and pupal fat body of Cecropia. Phosphorylase phosphatase in adult moth fat body is responsible for the decrease in concentration of active phosphorylase, without a decrease in total phosphorylase. In vitro, the rate of decrease varies with the ionic nature of the medium. Phosphorylase kinase, requiring ATP and Mg^{++} or Mn^{++}, mediates the conversion of active from inactive phosphorylase, and is highly active in adult cockroach fat body and only slightly active in adult flight muscle. Glucose, n-acetylglucosamine and trehalose inhibit the active phosphorylase of adult male moth fat body in a cell-free system, while sucrose, ribose and mannose do not. Fat body active phosphorylase per animal increases 3-fold during adult development without a significant change in total phosphorylase. In vitro incubation of cockroach corpus cardiacum or the retrocerebral complex of Cecropia does not activate Cecropia fat body phosphorylase. Under identical conditions cockroach fat body is always activated by roach corpus cardiacum. The inability of Cecropia fat body to respond to hormones by activation of phosphorylase is not due to the lack of enzyme systems capable of interconverting the inactive and active forms. Activation of phosphorylase in fat body of male L. maderae in vitro is maximal 10 min after the addition of corpus cardiacum extract. As little as 5×10^{-5} pair of corpora cardiaca per ml of incubation medium elicit an increase in active phosphorylase.

Female fat body, ovaries and the developing embryos of L. maderae show marked changes in glycogen related to events in the reproductive cycle. The activation of phosphorylase by extracts of corpora cardiaca from animals at various stages suggests that the hormone content of the gland is greatest at times when the glycogen level in the fat body is decreasing and the converse. Trehalose release by the fat body of male L. maderae in vitro is stimulated by the hormone. The percent stimulation reaches a maximum after 60 min of incubation. Incubation of fat body with extracts of corpus cardiacum stimulates O_2 consumption and decreases the respiratory quotient. The rate of oxidation of glucose-U-C^{14} to $C^{14}O_2$ and its incorporation into glycogen is also reduced. The hormone stimulates the oxidation of acetate-1-C^{14} and palmitate-1-C^{14} to the degree that the metabolic rate is increased, possibly compensating for the decrease in carbohydrate oxidation. Trehalose is synthesised from glucose-6-P (U-C^{14}) and UDPG more rapidly in a cell-free extract of tissue that had previously been incubated with corpus cardiacum extracts, suggesting an activation of trehalose-6-P synthetase. The data indicate that a corpus cardiacum hormone(s) regulates more than one site in the metabolism of glycogen. The hormone increases glycogen degradation by activation of phosphorylase and the phosphorylated hexoses are shunted into trehalose, rather than entering glycolysis at an accelerated rate. Consequently endogeneous fat body metabolism shifts toward the increased utilization of lipid. Mechanisms that may be responsible for these effects are discussed. (From DA)

106 Wiens, A.W., Gilbert, L.I. VARIATIONS IN THE GLYCOGEN CONTENT OF FAT BODY, OVARY, AND EMBRYO DURING THE REPRODUCTIVE CYCLE OF Leucophaea maderae. J. Insect Physiol. 13 (1967) 587-594.

Changes in the fat body glycogen reserves of female L. maderae during the reproductive cycle follow a biphasic curve during oogenesis and a large single phase of synthesis and degradation during embryogenesis. Glucose-U-^{14}C and palmitate-1-^{14}C were used. Glycogen in the ovary and developing embryos increases slowly except for a short-term rapid build-up in the last half of embryogenesis, which is rapidly depleted just prior to and following parturition. These changes are related to several other physiological events in the reproductive cycle and suggest a basis for further studies of the control of carbohydrate metabolism by hormonal or metabolic mechanisms.

107 Wiens, A.W., Gilbert, L.I. REGULATION OF CARBOHYDRATE MOBILIZATION AND UTILIZATION IN Leucophaea maderae. J. Insect Physiol. 13 (1967) 779-794.

Hormonal control of the phosphorylase system, metabolism of radioactive substrates, and trehalose synthesis were examined in the fat body. Fat body phosphorylase is maximally activated within 10 min after being exposed to corpus cardiacum extracts and is sensitive to very low concentrations of the extract. The concentration of phosphorylase-activating factor in the gland appears to be related to changes in glycogen content during oogenesis. The hormone elicits an accelerated rate of trehalose release, an increase in O_2 consumption, and a decrease in the respiratory quotient. The rate of oxidation of glucose to CO_2 is decreased, but that of acetate and palmitate are both increased in fat body incubated with corpus cardiacum extracts. A hypothesis considering the new metabolic effects of the hormone suggests that its regulatory action is effective at a number of different sites. - The following radioactive compounds were used in the study: glucose-6-phosphate, glucose-U-^{14}C, acetate-1-^{14}C, palmitate-1-^{14}C and trehalose-^{14}C.

108 Williams, M.W., Benson, N.R. TRANSFER OF C^{14} COMPONENTS FROM Psylla pyricola (Foer.) TO PEAR SEEDLINGS. J. Insect Physiol. 12, 2 (1966) 251-254.

Sorbitol was found to be the major ^{14}C-containing compound transferred from the insect P. pyricola (Foer.) to pear seedlings. Other ^{14}C components were also present in the seedlings but the amounts were too small to be identified. The psylla larvae transferred considerably more ^{14}C to the seedlings than did the adults. Analysis of psylla honeydew revealed that it contained 65% sorbitol, 22% sucrose, and 12% reducing sugars on a dry weight basis. (Auth.)

109 Wyatt, G.R. THE BIOCHEMISTRY OF SUGARS AND POLYSACCHARIDES IN INSECTS. p. 287-360 of "Advances in Insect Physiology, Vol.4". London, Academic Press, 1967, 415p.

Comprehensive review. The article is divided into sections on the occurrence of sugars in insects (glucose and reducing substances, trehalose, sugar content of insect haemolymph and of whole insects and insect tissues); intestinal absorption and the physiology of haemolymph sugar levels

(absorption from the gut, regulation of blood sugar); biosynthesis and utilization of sugars (glucose, use of monosaccharides other than glucose, biosynthesis, cleavage and use of trehalose, physiological roles of trehalose and trehalase, dormancy and the properties of trehalose); glycogen (in insects, accumulation and conversion during growth and metamorphosis, in insect flight, metabolism of glycogen); hormonal effects on carbohydrate metabolism; glycoproteins and chitin (glycoproteins in insects, metabolism of chitin); and on glycerol and sorbitol. - Extensive reference to radioisotope applications (author's own among others) are made throughout the text. A comprehensive bibliography is appended.

See also:

40 Some biochemical aspects of insect metamorphosis. (Gilbert, L.I. et al., 1961)

146 The course of protein and carbohydrate synthesis during oogenesis in Apis mellifica L. (Engels, W., 1965)

147 The time sequence in protein and carbohydrate synthesis in Apis mellifica. (Engles, W., (1966)

176 Action of ecdysone on some metabolism during larval-pupal transformation of the housefly, Musca domestica L. (Diptera: Muscidae) (Kobayashi, M. et al., 1967)

188 Studies of the mode of action of royal jelly in honeybee development: the utilization of sugar uniformly labeled with ^{14}C and of aspartic-1-^{14}C acid. (Lue, P.F. et al., 1967)

192 Studies on the salivary physiology of plant-bugs: transport from haemolymph to saliva. (Miles, P.W., 1967)

268 Radioisotope incorporation and nucleic acid synthesis in dipteran embryos. (Eudy, W.W. et al., 1967)

419 The deposition of endocuticle in an insect, Calpodes ethlius Stoll (Lepidoptera, Hesperiidae). (Condoulis, W.V. et al., 1966)

1.2.4. Amino Acids. Pteridines, Pyrimidines, Purines. Proteins. Enzymes. Hormones.

110 Agosin, M., Aravena, L., Neghme, A. ENHANCED PROTEIN SYNTHESIS IN Triatoma infestans TREATED WITH DDT. Expl Parasit. 16, 3 (1965) 318-324.

The effect of DDT and DDE, a DDT-non toxic analogue, on protein biosynthesis in T. infestans nymphs and adult specimens has been studied. DDT increases the in vivo rate of incorporation of DL-leucine--1-^{14}C into total proteins, while a slight inhibitory effect is observed in adult males. DDE does not appreciably change the rate of protein biosynthesis in nymphs, although it appears to be inhibitory in males. Nymphal microsomes and sarcosomes show the highest specific activity after DL-leucine-^{14}C injection. This activity is markedly increased by DDT, while DDE again is inhibitory. A cell-free system obtained from nymphal specimens incorporates DL-leucine-1-^{14}C into proteins in the presence of ATP, an ATP-generating system, GTP, and Mg ions. In vivo pretreatment with DDT at low concentrations increases the rate of DL-leucine-1-^{14}C incorporation into protein by this system. In vitro added DDT also is stimulatory at very low concentrations, while higher ones are inhibitory. The results obtained indicate that protein biosynthesis is stimulated by DDT, but not DDE; an effect that is only evident in nymphal T. infestans. This appears to be consistent with the inductive effect of DDT previously shown with NAD-kinase in this organism (Ilevicky et al., 1964). (Auth.)

111 Agosin, M., Fine, B.C., Scaramelli, N., Ilivicky, J., Aravena, L. THE EFFECT OF DDT ON THE INCORPORATION OF GLUCOSE AND GLYCINE INTO VARIOUS INTERMEDIATES IN DDT-RESISTANT STRAINS OF Musca domestica L. Comp. Biochem. Physiol. 19 (1966) 339-349.

House fly strains showing various patterns of cross-resistance to insecticides have remarkable metabolic differences as to levels of NADP, relative participation of glycolysis and the pentose phosphate pathway in glucose utilization, rates of protein synthesis and glutathione turnover. Labelled glucose (uniformly ^{14}C-labelled, glucose-1-^{14}C, glucose-2-^{14}C, and glucose-6-^{14}C) was used. DDT treatment stimulates the pentose phosphate pathway, increasing the availability of NADPH*, and

* NADP, oxidized nicotinamide adenine dinucleotide phosphate; NADPH, reduced nicotinamide adenine dinucleotide phosphate.

enhances the rates of protein synthesis and glutathione turnover in a pyrethrin-resistant strain, which is also cross-resistant to DDT. On the other hand, a susceptible strain did not evidence any of the above DDT effects. It is suggested that the metabolic changes observed are closely linked to the activity of detoxifying enzymes and constitute an expression of insecticide resistance.

112 Agosin, M., Ilivicky, J., Litvak, S. THE INDUCTION OF NAD KINASE BY DDT IN Triatoma infestans. Can.J. Biochem. 45, 5 (1967) 619-626.

The NAD kinase (EC 2.7.1.23) from T. infestans was purified and a specific antiserum against it prepared. Immunochemical techniques showed that the increase in the levels of NAD kinase in nymphs of T. infestans was accompanied by an increase in the amount of enzyme protein. The enzyme is labelled after injection of ^{14}C-labelled leucine in both induced and non-induced insects, but labelling is greater in the former, which further supports the concept that a de novo synthesis of enzyme protein occurs during induction by DDT. The enzyme is heterogeneous by DEAE-cellulose and DEAE-Sephadex column chromatography but the antiserum does not distinguish this heterogeneity. NAD kinase induction may correspond to a protective mechanism of the insects by increasing the availability of coenzymes required for DDT detoxication. (CA 67: 1967, 10648q)

113 Allen, R.R., Newburgh, R.W. AMINO ACID-ACTIVATING ENZYMES IN Sarcophaga bullata. Comp Biochem. Physiol. 17, 1 (1966) 309-317.

Amino acids were studied in the supernatant from fat bodies from the larval and pupal stages of the fly. The enzymes were examined by the pyrophosphate-ATP exchange method. The optimal pH for pyrophosphate-^{32}P-ATP exchange was 7.6 in the presence of 10 mM Mg. The exchange rate varied with the amino acid substrate, but the total activity decreased with age for the 1st 6 d of pupal life then increased to a max. 1-2 d before adulthood. Free amino acid concentration in the pupae decreased during the period of amino acid-activating activity. (CA 64: 1966, 13141f)

114 Atallah, Y.H., Killebrew, R. ECOLOGICAL AND NUTRITIONAL STUDIES ON Coleomegilla maculata: AMINO ACID REQUIREMENTS OF THE ADULTS DETERMINED BY THE USE OF C^{14} LABELED ACETATE. Ann. ent. Soc. Am. 60 (1967) 186-188.

Fifty adult Coleomegilla maculata (De Geer) were fed on 250 ml of an aqueous solution of sodium acetate-1-^{14}C which contained 600 µg of the salt; total ^{14}C was 10 µCi. After 4 h, the beetles were homogenized, the amino acids were extracted and separated by thin-layer chromatography, and the activity was measured, using a scintillation counter. Glycine, serine, aspartic acid, glutamic acid, proline, and lysine showed high activity, and are considered to have been synthesised in vivo. They are apparently nonessential, in contrast to threonine, phenylalanine, isoleucine, and valine, which are essential or derived exclusively from essential dietary constituents. The low activity shown by alanine, leucine, arginine, and histidine indicated a low level of ^{14}C incorporation. Three unknown ninhydrin-positive compounds were isolated, in addition to the 19 amino acids that were identified. (Auth.)

115 Berendes, H.D. THE HORMONE ECDYSONE AS EFFECTOR OF SPECIFIC CHANGES IN THE PATTERN OF GENE ACTIVITIES OF Drosophila hydei. Chromosoma 22, 3 (1967) 274-293.

The hormone ecdysone induces a large number of changes in the puffing pattern of mid 3rd instar larvae of D. hydei. The pattern of changes occurring after experimental administration of the hormone are identical with those observed in normal development during a 6-h period before puparium formation. After administration of the hormone a considerable number of puffs react with a change in activity within 15-20min. During this period 3 puffs arise newly, 12 puffs show a strong increase in activity, 6 puffs show a less pronounced increase in activity and 12 puffs show a decrease in activity. At a period of 4-6 h after administration of the hormone another 5 puffs arise newly. The effect of the hormone was identical in both in vivo and in vitro experiments. – Diameter measurements on several puffs reacting within 30 min with an increase in diameter showed that these puffs reacted simultaneously. Most of the puffs that showed a decrease in activity reacted with some delay. – A study of the effect of different hormone concentrations revealed that the kinetics of 4 puffs with respect to the relationship between concentration and puff size was identical over a range of concentrations from 33.10^{-5} to 33 CU/µl. Three of these puffs showed a reaction with even lower concentrations. Maximum puff size is attained by all puffs at a concentration of 33.10^{-4} CU/µl.

Among the puffs studied no difference in their reaction threshold was found. – A study of the behaviour of 5 puffs of the group reacting within 15-20 min and one of the group reacting after 4-6 h in midintestine and Malpighian tubules revealed that these puffs showed the same reaction after injection of the hormone as observed in the salivary glands. – Chromosomal RNA synthesis was studied by injecting the larvae with 1 µl of an ecdysone solution (33 CU/µl) containing 1 µCi of uridine-^{3}H (specific activity 16.600 mCi/mM), the salivary glands being prepared 30 min after injection. Specific labelling of the activated puffs was improved by injecting uridine-^{3}H into larvae that were injected with an ecdysone solution 30 min earlier. The glands were prepared at 3 min after injection of the uridine. All puffs activated by administration of the hormone showed particularly strong uptake of ^{3}H uridine and accumulation of acidic protein. – Ecdysone is concluded to induce a pattern of changes in gene activity that is far more complex in D. hydei than in Chironomus tentans.

116 Berendes, H.D. AMINO ACID INCORPORATION INTO GIANT CHROMOSOMES OF D. hydei. Drosoph. Inf. Serv. 42 (1967) 102-103.

Staining salivary gland chromosomes with Fast green at pH 2.4 revealed that normally occurring puffs as well as those produced by a temperature shock contain a high amount of proteins which are absent in the non-puffed condition of these regions. Various ^{3}H amino acids were injected into larvae to trace their incorporation into the chromosomes and the possible relation of protein synthesis to the origin of puffs. No preferential labelling, after the injection of 140-h-old larvae with 1 µl of ^{3}H-tryptophan (specific activity 3.02 Ci/mM), of the induced puffs was ever observed. In many cells the number of grains over the puffed region was even lower than over the neighbouring part of the chromosome. In many cases, however, certain unpuffed bands showed a reproducable preferential labelling. None of the puffs specific for puparium formation which arise during the period of incubation showed a preferential uptake of the labelled amino acid. Similar results were obtained with proline, histidine, leucine and arginine. On account of these data it is clear that the regional increase in protein content during puffing is not caused by a synthesis in the puff itself, but is presumably due to an accumulation of pre-existent proteins from some place in the cell. Larvae of 136 h showed amino acid labelling in 100% of the salivary gland nuclei after 5 h of incubation. After the same period of incubation with ^{3}H-thymidine only 37-46% of the nuclei of similar glands were labelled. It therefore might be suggested that there is no apparent correlation between chromosomal protein synthesis or accumulation and chromosomal replication. (From DIS)

117 Biryukova, N.V., Kullyev, P., Mamedniyazov, O.N. INCORPORATION OF LABELED AMINO ACIDS INTO THE FIBROIN IN THE SILK-SECRETION GLAND OF Bombyx mori. Izv. Akad. Nauk turkmen. SSR, Ser. Biol. 1 (1966) 58-63. (In Russian).

B. mori caterpillars were given glycine-^{14}C, DL-alanine-^{14}C, DL-lysine-^{14}C, DL-methionine,-^{35}S, or 0.1 ml 0.14M NaCl in the fall. After 3 h, their silk-secretion glands were removed, homogenized, and radioactivity measured. Fibroin synthesis reached its max. some days after completed RNA formation in glandular cells and increased incorporation of labelled amino acids into total protein as well as accumulation of the secretion occurred in the 2nd half of the 5th growth phase of the caterpillars. (CA 65: 1966, 14159b)

118 Boyd, J.B. PART I: TURNOVER OF THE HEMOLYMPH PROTEINS OF Drosophila melanogaster. PART II: A NEW METHOD FOR THE DETECTION OF DEOXYRIBONUCLEASES AND ITS APPLICATION TO STUDIES OF Drosophila melanogaster. Diss. Abstr. 26, 8 (1966) 4203.

In part I, a method is described developed for measuring the radioactivity of proteins labelled with ^{14}C or ^{3}H following their separation by disc electrophoresis. The radioactivity is measured directly in acrylamide gel with scintillation techniques after the water in the gel has been replaced with a toluene-based scintillator solution. 74 Gel slices can be prepared with a minimum of handling in 9-18 h depending upon the size of the slices. This technique has been used in combination with densitometry measurements of separately stained gels to study the turnover of the haemolymph proteins of D. melanogaster. By injecting labelled homologous proteins into unlabelled animals, active turnover of most of the haemolymph proteins has been demonstrated in both larvae and pupae. One particular group of proteins begins to turn over rapidly after puparium formation with a half life of 13 h. Another group of proteins has been shown to be relatively inert in pupae. A postulated mechanism for protein turnover in metamorphosing insects is discussed. No radioisotopes were used in part II.

119 Boyd, J.B., Mitchell, H.K. TURNOVER OF THE HEMOLYMPH PROTEINS OF Drosophila melanogaster. Archs Biochem. Biophys. 117 (1966) 310-319.

Turnover of the haemolymph proteins of D. melanogaster was studied with the aid of disc electrophoresis. By injecting labelled homologous haemolymph proteins into unlabelled animals, active turnover of the major haemolymph proteins was demonstrated in both larvae and pupae. Parallel experiments with a heterologous protein demonstrated that the observed turnover was specific for homologous proteins. One group of haemolymph proteins turned over rapidly after puparium formation, with an average half-life of 13 h. Another group of proteins was relatively inert in pupae. (CA 66: 1967, 679e).

120 Bricteux-Grégoire, S., Verly, W.G., Florkin, M. PROTEIN SYNTHESIS IN Sphinx ligustri PUPAE. Nature, Lond. 179 (1957) 678-679.

The study was aimed at determining whether the larval proteins are hydrolysed to free amino acids before being used for adult protein synthesis, or whether adult proteins are built up from larger units that might be carried by phagocytes which are known to destroy the larval tissues. The mean specific rates of protein synthesis (rate of synthesis/amount of proteins) from one free amino acid, glycine, in Sphinx ligustri puape, either in diapause or at the moment of the development of the adult organs were compared. 112 μg of glycine -1-^{14}C (433 000 Ci/min) was injected into the body cavity of each of five pupae. The mean specific rate of non-blood protein synthesis from free glycine proved much higher in the transforming pupa than in the diapausing animal. This seems to support the view of adult protein synthesis occurring directly from the free amino acid pool.

121 Brookes, V.J. THYMIDINE KINASE AND THYMIDYLATE KINASE IN THE SILKWORM, Antheraea pernyi. Biochim. biophys. Acta 119, 2 (1966) 268-275.

Thymidine and thymidylate kinases were assayed by a chromatographic method (cf. J. biol. Chem. 238:1963, 1467) in terms of the disappearance of [2-^{14}C] thymidine and the formation of phosphorylated products, deTMP, deTDP, and deTTP. Thymidine kinase (ATP: thymidine-5'-phosphotransferase, EC 2.7.1.21) and thymidylate kinase were extracted from the wing epidermis of developing adults of Antheraea pernyi and partially characterized. Activity of both enzymes was low in dialysed extracts unless Mg^{2+} was added. Non-dialysed extracts contained sufficient Mg^{2+} for the full activation of thymidine kinase but not for full activation of thymidylate kinase. High concentrations of Mg^{2+} or of ATP inhibited thymidine kinase but this inhibition disappeared when both cofactors were added in equimolar concentrations. High concentrations of thymidine also inhibited thymidine kinase; this inhibition was diminished by lowering the concentration of ATP. Thymidine kinase was inhibited about 45% when thymidine and deTTP were equimolar. deCTP also inhibited thymidine kinase but to a lesser degree; i.e. by about 50% when the deCTP concentration was 10 times that of thymidine. deGTP and deATP caused no detectable inhibition. However, to a certain extent, these factors were able to satisfy the requirements for ATP.

122 Brunel, C. ANALYSE DE QUELQUES DERIVES PURIQUES ET PYRIMIDIQUES ACIDO-SOLUBLE DANS LES GLANDES SERICIGENES CHEZ Bombyx mori. Thesis, Lyon Univ. (France), 1965.

The thesis consists of two parts. The first concerns the development of a column-chromatographic method* for fractionating acid-soluble nucleotides of the silk gland of Bombyx mori. The second part is devoted to the study of these nucleotides. With the exception of CTP (cytidine triphosphate) and UTP (uridine triphosphate) all the simple ribonucleotides have been identified: AMP, ADP, ATP (adenosine mono-, di- and triphosphate); GMP, GDP, GTP (guanosine mono-, di- and triphosphate); UMP (uridine monophosphate) and several UDP; CMP and CDP (cytidine mono- and diphosphate). These results are compatible with those obtained for other animal tissues, and the order of elution of the nucleotides corresponds to that given by Hurlbert et al. Possible explanations for the absence of CTP and UTP are put forward. Orotic acid, a precursors of the pyrimidine bases, was used in radioactive (orotic-6-^{14}C) form but did not yield further information.

* To some extent a modification of Hurlbert's method (J. biol. Chem. 209: 1954, 23).

123 Burdette, W.C., Coda, R.L. EFFECT OF ECDYSONE ON INCORPORATION OF C^{14}-LEUCINE INTO HEPATIC PROTEIN IN VITRO. Proc. Soc. exp. Biol. Med. 112 (1963) 216-217.

As much as a 10-fold increase in incorporation of leucine occurred when ecdysone was present. DL-leucine was labelled in position 1 with ^{14}C. The level of incorporation was increased significantly

(t test) when ecdysone was present in concentrations of ≥ 250 Calliphora units (c.u.)/ml and the activity of leucine adjusted to 10 mCi/mM. The effect was more pronounced with higher doses, and a threshold was present at concentrations > 100 c.u./ml. It would appear that extracts of Bombyx containing ecdysone activity (Calliphora test) enhance the rate of synthesis of mammalian protein in vitro.

124 Bursell, E. ASPECTS OF THE FLIGHT METABOLISM OF TSETSE FLIES (Glossina). Comp. Biochem. Physiol. 19, 4 (1966) 809-818.

Injection of ^{14}C-labelled amino acids and the tracing of the radioactivity in extracts of thoracic muscles of the tsetse fly after flight show that proline is the substrate for flight metabolism. During flight proline is converted to glutamic acid and subsequently to alanine. (CA 65: 1967, 26873 z)

125 Bursell, E. THE EXCRETION OF NITROGEN IN INSECTS. p.33-67 of "Advances in Insect Physiology. Vol. 4". London, Academic Press. 1967, 415p.

This review article is divided into two main parts: the formation and the excretion of nitrogenous end products. The first deals with the uricolytic and the uricotelic pathways, the formation of urea and ammonia, and with amino acids and some other N-containing substances. The excretion of nitrogenous end products is considered in Collembola, Orthoptera, Odonata, Dermoptera, Hemiptera, Coleoptera, Neuroptera, Hymenoptera, Diptera, and Lepidoptera. The tremendous progress made in the last 15 years is stressed, as are the remaining complexities of insect excretory metabolism. - In some unpublished work Bursell has shown that arginie becomes rapidly labelled following injections of ^{14}C-glutamate; this substance may therefore play a more active role in excretion than had originally been envisaged. - A number of studies are cited in which radioisotopes had been used but no mention of this is made in the text.

126 Bursell, E. THE CONVERSION OF GLUTAMATE TO ALANINE IN THE TSETSE FLY (Glossina morsitans). Comp. Biochem. Physiol. 23, 3 (1967) 825-829.

A series of experiments was carried out to determine whether the pattern of incorporation of radioactivity from glutamate labelled in the 1, the 5, or the 3,4 position into alanine molecules would conform to expectations for a previously proposed pathway for this conversion in flight metabolism in G. morsitans. The level of incorporation from glutamate-3,4 ^{14}C was significantly higher than that from glutamate-5-^{14}C, which was greater than that from glutamate-1-^{14}C. Results were the same when resting flies or flies flown for 1.5 min were used. These results support the view that the previously proposed metabolic pathway is operative in the tsetse fly. (CA 68: 1968, 47363 f).

127 Cassidy, J.D. BASE ANALOGUE INCORPORATION IN THE FEMALE GERM PLASM OF Microbracon hebetor Say. J. Insect Physiol. 13 (1967) 487-493.

The biochemical fate of an ingested purine analogue was traced in adult female braconid wasps and their ova. Synchronous oögenesis facilitated day-to-day radiometric analysis of germinal cell lines treated in vivo. The data showed differential incorporation of ^{14}C-8-azaguanine into various cell types. Maximum isotopic incorporation occurred in the most differentiated oöcytes. The same meiotic cells expressed maximum analogue susceptibility as measured by the proportion of aberrant embryos. Homogenates of embryonic wasps derived from treated cells were used for extraction of five metabolic fractions. Incorporation occurred in DNA and RNA, and analogue transmission was identified to the 3rd generation. Biochemical, genetical, and cytological results suggest an alteration in the transcription of genetic information for cellular specialization and early braconid development. (Auth.)

128 Chan, S.K., Margoliash, E. BIOSYNTHESIS OF CYTOCHROME c IN DEVELOPING PUPAE OF Samia cynthia. J. biol. Chem. 241 (1966) 2252-2255.

The content of cytochrome c in metamorphosing pupae of the saturnid moth, Samia cynthia, rises rapidly from an undetectable level during the final 2-3 d of development. To test whether this increase in cytochrome c during the later stages of development is a consequence of protein synthesis de novo, ^{14}C-L-arginine (5.8 mμM, uniformly labelled, 174 mCi/mM) was injected into the middorsal line of the 3rd abdominal segment on the 17th day immediately before the rapid rise in the concentration of the protein. A total of 1.50 μM of cytochrome c was recovered from the 200 animals 2 d after adult emergence. The incorporation of ^{14}C-L-arginine into tryptic peptides from S. cynthia

cytochrome c and their characterization was studied and the results are tabulated. The increase in cytochrome c could be shown to result from de novo synthesis of the entire polypeptide chain.

129 Chaudhary, K.D., Srivastava, U., Lemonde, A. MONOAMINE OXIDASE IN Tribolium confusum Duval. Biochim. biophys. Acta 132, 2 (1967) 290-299.

Certain biochemical characteristics of monoamine oxidase (monoamine: O_2 oxidoreductase (deaminating), EC 1.4.3.4) in T. confusum homogenate have been determined by using a radioisotope method (^{14}C-tryptamine). Like the mammalian enzyme, the insect monoamine oxidase shows maximum activity at pH 7.4. Besides, this enzyme possesses a very high affinity for tryptamine used as substrate ($K_m = 8.7 \times 10^{-5}$ M) and has an activation energy (ΔE) of the order of 10440 cal/mol within the limits of optimum temperature (37° C). At a final concentration of 0.5 M, EDTA causes about 70% loss in the activity. Addition of Zn^{2+} and Co^{2+} (final concentration 10^{-3} M of each) in the presence of EDTA not only recovers the lost activity but also activates the enzyme considerably. Both pamate sulfate and harmine inhibit monoamine oxidase reversibly, their respective inhibition constants (K_i) being 0.26×10^{-3} M and 1.4×10^{-3} M. Monoamine oxidase activity is lodged in the particulate fraction of which the mitochondria, in terms of specific activity, contains about 5.7 times more activity than nuclei. The enzyme is tightly bound to mitochondria. During the life cycle of the insect, monoamine oxidase titer follows a more or less inverse trend to that of acetylcholinesterase (acetylcholine acetyl-hydrolase, EC 3.1.1.7).

130 Chefurka, W. INTERMEDIARY METABOLISM OF NITROGENOUS AND LIPID COMPOUNDS IN INSECTS. p. 669-768 of "The Physiology of Insecta. Vol.2". Rockstein, M., Ed. New York, Academic Press Inc. 1965.

This review is divided into sections dealing with the breakdown of proteins (subdivided into endopeptidases and exopeptidases); the transamination, decarboxylation, and oxidation of amino acids (D- and L-amino acid oxidases), and the metabolism of amino acids (glutamic acid, glycine, serine, alanine, lysine, arginine, sulphur amino acids, tryptophan, and aromatic amino acids); end products of N metabolism; metabolism of pterins; the synthesis of proteins (in whole cells and cell-free systems, and in relation to amino acid incorporation and to nucleic acid metabolism); and finally lipid metabolism (oxidation and synthesis of fatty acids). The extensive bibliography contains numerous references to work utilizing radioisotopes.

131 Chen, P.S. AMINO ACID AND PROTEIN METABOLISM IN INSECT DEVELOPMENT. p.52-132 of "Advances in Insect Physiology. Vol.3". Beament, J.W., Treherne, J.E., Wigglesworth, V.B., Eds. London, Academic Press. 1966, 382p.

Comprehensive review article, dealing with embryonic development (changes in free amino acid pools, and enzyme patterns); larval development (amino acids peptides and other amino acid derivatives, and haemolymph proteins); pupal development (metabolism of amino acids and proteins, and changes in enzyme activities); and the adult, in terms of sex-specific differences in amino acids, peptides and proteins, and protein metabolism in relation to reproduction. A section is devoted to some genetic aspects of protein metabolism in insects, and deals with patterns of protein metabolism in lethal mutants, synthesis of enzymes and other specific proteins, and the regulation of gene activity. It is clear that profound changes in protein metabolism take place at various periods during insect development. The major morphogenetic events, such as the determination of the organ (anlagen) during embryogenesis, growth and moulting during larval life, as well as transformation from larva to pupa at metamorphosis are accompanied by characteristic variations in the patterns of amino acids, peptides and proteins. A reasonable picture of the causal relationship of hormone action, protein synthesis, growth and differentiation has been provided by physiological and biochemical studies, though the precise mechanism involved is still far from clear. The genetic aspect of protein metabolism has been reviewed to a very limited extent on hand of a few selected examples. - A very extensive bibliography is appended. In a large number of studies radioisotopes were used, a fact which is not always brought out in the text.

132 Chen, P.S., Levenbook, L. STUDIES ON THE HAEMOLYMPH PROTEINS OF THE BLOWFLY Phormia regina - CHANGES IN ONTOGENETIC PATTERNS. J. Insect Physiol. 12 (1966) 1595-1609.

In order to examine the breakdown process more critically experiments were carried out entailing the injection of ^{14}C-labelled larval haemolymph into various developmental stages of the black blowfly P. regina. By following the formation of $^{14}CO_2$ and the distribution of radioactivity in both the free

amino acid pool and protein fractions following the injection of labelled haemolymph proteins, the extent of protein degradation was estimated. Detailed analyses of the haemolymph during development of blowfly P. regina have demonstrated a 12-fold increase in haemolymph volume during the 2nd to 5th day of larval life. Within the same period the total concentration of proteins increases about 24-fold, and reaches a max. value of about 20% (w/v) shortly before pupation. During metamorphosis both haemolymph volume and haemolymph protein concentration fall distinctly, the most rapid decline occurring during the time of transformation from larva to white pupa and at adult emergence. In the newly emerged flies the total protein concentration amounts to 3.5% (w/v) which is only about one-sixth of that in the mature larva. Acrylamide gel electrophoresis indicates the presence of at least 19 protein bands in haemolymph. Characteristic changes in the ontogenetic patterns have been observed during development, including the appearance of new protein fractions and the disappearance of others in both pupal and adult stages. Furthermore, the distinct difference in the electrophoretic patterns between haemolymph and moulting fluid is indicative of the different origin of the respective protein components.

133 Chen, P.S., Levenbook, L. STUDIES ON THE HAEMOLYMPH PROTEINS OF THE BLOWFLY Phormia regina - II. SYNTHESIS AND BREAKDOWN AS REVEALED BY ISOTOPIC LABELLING. J. Insect Physiol. 12 (1966) 1611-1627.

The breakdown of proteins during metamorphosis of the blowfly P. regina was investigated by injecting ^{14}C-labelled haemolymph protein into larvae, pupae, and developing adults. Measurements of $^{14}CO_2$ production and radioactivity in free amino acids indicate that the breakdown process is phase-specific; it begins in the mature larva shortly before puparium formation and reaches a max. in the white pupa. However, the overall rate of protein degradation is very low, and amounts to only about 5-15% of the injected dose 10 h after injection. Analyses of adult flies which received labelled haemolymph protein before pupation showed that about three-quarters of the total body radioactivity was in the tissues. On the basis of this finding and the fact that the total free amino acid concentration remains essentially unchanged during metamorphosis, the possibility of a direct utilization of larval haemolymph proteins by adult tissues is suggested. Injection of ^{14}C-labelled Chlorella protein hydrolysate showed that incorporation of the radioactive amino acids into haemolymph proteins is most rapid during the growth period of larval life. The corresponding values for pupae are very low, and progressively decline during the course of metamorphosis. (Auth.).

134 Chitra, C., Shyamala, M.B. ACCUMULATION OF GLYCINE IN THE FAT BODY OF THE SILKWORM, Bombyx mori L. Nature, Lond. 216 (1967) 386-387.

When glycine-2-^{14}C was administered in vivo to 5th-instar larvae, 96% of the radioactivity was incorporated into various tissues within 1 h whereas in vitro only 19% of the activity was transported by the mid-gut. This suggests that continued absorption of glycine by the intestine could be aided by a facilitated diffusion mechanism in which amino acids are rapidly removed from the site of absorption either by accumulation into other tissues or by degradation. The experiments described show that the silkworm fat body possesses an efficient mechanism for accumulating glycine and that both the accumulation and the release of glycine are metabolically controlled. Glycine uptake was studied by suspending 50 mg of fat body in 0.5 ml of Ringer solution containing 5 µl of glycine-2-^{14}C (specific activity 0.1 mCi/9.8 mg dissolved in 2 ml) and 7.5 mg of carrier glycine (200 m$\underline{M}$/l Ringer solution). Comparison between middle 5th instar and spinning larvae shows a statistically significant reduction in uptake even at the early spinning stage (see typical double-layered plasma membrane for the fat body cell discovered presumably corresponding to discrete structures in fat body cells discovered electron microscopically in Philosamia cynthia by other workers).

135 Chmurzyńska, W., Zielińska, Z. METABOLIZM FRAGMENTOW JEDNOWEGLOWYCH U OWADOW. I. INKORPORACJA WEGLA Z ^{14}C MROWCZANU DO NIEKTORYCH WOLNYCH AMINOKWASOW HEMOLIMFY Acantholyda nemoralis (Thoms). (Metabolism of monocarbon fragments in insects. I. Incorporation of carbon from ^{14}C formate into certain free amino acids of the haemolymph of Acantholyda nemoralis (Thoms)) p. 67 of "Biochemistry of Lipids". 4th Symposium of the Polish Biochemical Society. 11-12 Jun. 1965." Abstr.

A solution of ^{14}C formate (0.08 µCi/100 mg insect weight) was injected into larvae (♀) of Acantholyda at diapause. Free amino acids were isolated from haemolymph taken a certain time after injection and were separated by paper chromatography; after elution the radioactivity of the individual amino acids was measured by means of a Micromil (Nuclear Chicago Co.) end-window counter. The

incorporation of ^{14}C into alanine, glycine, methionine and serine was established. The specific activity of the alanine and glycine was about 700 and 150 cpm/μM in these experiments, in which the similarly determined specific activity of serine and methionine reached 20 000 cpm/μM or even more. The high activity of the serine, also the high activity of the enzymatic systems bringing about synthesis and interconversion of the active monocarbon fragments (Grzelakowska, Zielińska) give grounds for believing that the incorporation of ^{14}C formate into serine occurs with the participation of the enzymatic systems in question. The high radioactivity of the methionine may indicate a considerable metabolic activity of this amino acid. (From translated abstr.)

136 Clarke, J.M., Maynard-Smith, J. INCREASE IN THE RATE OF PROTEIN SYNTHESIS WITH AGE IN Drosophila subobscura. Nature, Lond. 209 (1966) 627-629.

Flies were fed a solution of 5×10^{-4} M ^{3}H-leucine in 10% sucrose, with a specific activity of 0.5 mCi/ml. Label can be detected from within 5-10 min of the start of feeding. Flies were allowed to feed for 1 h. The mean survival time of even the most rapidly turning-over species of protein molecule must be at least 100 h, and may be much greater. The rate of protein synthesis is about twice as great in old as in young flies. Possible interpretations are discussed.

137 Clarke, K.U., Gillott, C. STUDIES ON THE EFFECT OF THE REMOVAL OF THE FRONTAL GANGLION IN Locusta migratoria L. - I. THE EFFECT ON PROTEIN METABOLISM. J. exp. Biol. 46, 1 (1967) 13-25.

Studies were made on the 3rd-, 4th-, and 5th-instar nymphs of L. migratoria L. from which the frontal ganglion had been removed, on control-operated, and on starved animals. The effects of this operation on protein metabolism were observed by study of: electrophoresis of haemolymph proteins, chromatography of heamolymph amino acids, production of protease in the midgut, and the incorporation of ^{14}C-glycine into protein by the body cells. Third-instar locusts were injected with ^{14}C-glycine (specific activity 8.0 mCi/mM , 106.7 μCi/mg) in distilled water (concentration 0.1 mCi/ml) either as a fixed volume (5 μl) or as a proportion of the body weight (1 μl/20 mg). The total protein concentration in the haemolymph of operated locusts did not increase with time as did that of controls, in which the increase was almost entirely due to changes in the second of the three bands which normally separate out. The concentration of the free amino acids in the haemolymph fell to about 70% of that in operated controls. In operated locusts the proportions of the amino acids relative to one another changed. The incorporation of ^{14}C-glycine into protein was slower and the equilibrium concentration less in operated than in control-operated animals. The time taken to reach equilibrium was the same in both cases. In both operated and control-operated animals the protease activity of the mid-gut wall was very low; no difference could be detected between them. The protease activity of the mid-gut contents expressed per mid-gut was lower in operated than in control-operated animals. The protease activity expressed per mg was found to be the same in operated, control-operated and starved animals. The hypothesis that the effects of the removal of the frontal ganglion were mediated through changes in the secretion of hormones from the corpus cardiacum was tested by giving daily injections of freshly prepared corpus cardiacum extract to locusts from which the frontal ganglion had been removed and observing the growth in weight of these animals. A permanent increase in weight amounting to 100% of their initial weight was found. Animals injected with distilled water showed a temporary increase amounting to 30%. Uninjected animals maintained approximately constant weight. (Essentially auth. summary)

138 Cline, R.E., Pearce, G.W. UNIQUE EFFECTS OF DDT AND OTHER CHLORINATED HYDROCARBONS ON THE METABOLISM OF FORMATE AND PROLINE IN THE HOUSEFLY. Biochemistry 2 (1963) 657-662.

Insecticide-treated and control flies were injected with ^{14}C-labelled biochemicals, and 3 h later the soluble radiometabolites were extracted for identification and assay by paper chromatography and radiometric techniques. Of the injected compounds, DDT was found to interfere most with the metabolism of formate, glycine and proline. Thus after injection of ^{14}C-formate, more uric acid and allantoin and less proline were recovered as radiometabolites from flies treated with DDT and related hydrocarbon insecticides than from flies untreated or treated with nontoxic analogues. However, insecticides of other types such as pyrethrum, organic phosphates, and phosphonates and a carbamate, interestingly, failed to show a significant effect on formate metabolism, providing additional evidence for a different mode of action. (Auth.)

139 Coles, G.C. STUDIES ON RESILIN BIOSYNTHESIS. J. Insect Physiol. 12 (1966) 679-691.

The cells that deposit resilin in Schistocerca gregaria have been studied to test the hypothesis that this protein is formed by the cross-linking of proresilin by a peroxidase enzyme. A peroxidase, resembling that from horse-radish, is present in these cells, and also in the gut, flight muscle, and cuticle with attached epidermal cells. There are proteins in the cells that deposit resilin that can be cross-linked by the peroxidase enzyme to form di- and trityrosine residues. However, it cannot be concluded that the natural function of the peroxidase enzyme is to cross-link proresilin and similar cuticular proteins because it has not been possible to demonstrate its presence in the cuticle or at the surface of the epidermal cells. The difficulties of providing conclusive evidence for the existence of proresilin are discussed. Both the in vivo and in vitro incorporation of ^{14}C-tyrosine show that only a short time is required for incorporation of free tyrosine into resilin cuticle, indicating a rapid turnover of proresilin and suggesting that only a small pool is present. Some observations on chitin synthesis by these cells are reported. The incorporation of ^{14}C-glucose and -glucosamine was used to investigate the synthesis of chitin by "resilin cells".

140 Collins, J.V., Locke, M. THE SEQUESTRATION OF PROTEIN BY FATBODY CELLS IN AN INSECT. J. Cell Biol. 31, 2 (1966) 23A. Abstracts of Papers presented at the "6th Annual Meeting of the American Society for Cell Biology, Houston, Tex., USA. 17-19 Nov. 1966". Abstr. 42.

The fat body of metamorphosing holometabolous insects stores protein in the form of granules. In the larva of Calpodes ethlius Stoll (Lepidoptera: Hesperiidae), the granules begin to form about 30 h before pupation. Most of the protein in the granules is sequestered over a period of 16 h. The source of the protein sequestered has been demonstrated in two ways. The incorporation of ^{3}H-tyrosine and -leucine into the protein of the granules was observed radioautographically. The level of incorporation into the fat body is no higher at the time of granule formation than at any other time during the stadium. In contrast, there is considerable incorporation into the epidermis. It is unlikely that the fat body synthesises much of the protein in the granules at this time. An alternative hypothesis is that the protein is sequestered from the blood. The concentration of blood protein increases steadily throughout the stadium and decreases during the period of granule formation. Females have a higher concentration of blood protein than males, and a higher proportion of protein in the fat body cells. Horse-radish peroxidase injected into the haemolymph during the early phase of granule formation is sequestered mostly into the granules. It is concluded that the fat body sequesters blood protein to make the protein granules. The high concentration of blood protein is not a sufficient stimulus for sequestration. The cells fail to form protein granules if the source of the moulting hormone is removed, although the blood protein concentration may be max. at that time. Electron micrographs of fat body cells during granule formation show that blood protein is concentrated in intercellular and intracellular channels, from which vesicles bud off into the cytoplasm. This mechanism differs from that involved in yolk protein uptake in oocytes. (Abstr.)

141 Collins, J.V. THE FORMATION OF PROTEIN GRANULES IN THE FAT BODY OF AN INSECT, Calpodes ethlius Stoll, LEPIDOPTERA, HESPERIIDAE. Diss. Abstr. 28, 6 (1967) 2269-B – 2270-B.

The fat body of metamorphosing holometabolous insects stores protein in the form of granules. In the larva of C. ethlius Stoll (Lepidoptera, Hesperiidae), the granules are formed over a period of 18 h beginning 30 h before pupation. Grain counts of autoradiographs show that although the fat body synthesises protein during the intermoult, the rate of incorporation of ^{3}H-amino acids is lowest at the time of granule formation. The granules contain little newly synthesised protein and are formed from protein taken up from the blood. This conclusion is supported by the changes in amount of protein reserves in the blood throughout the stadium. The concentration of protein in the blood is constant from the 4th-5th moult until the critical period for the action of the brain on the prothoracic glands 66 h later. It then increases until the end of the intermoult at the time of the activation of the tissues by the prothoracic glands. This correlation between blood protein synthesis and the critical period for the action of the brain hormone has not been made in other insects. Following this critical period there is a sudden decrease in the concentration which exactly coincides with the formation of the protein granules. There is a sex difference in the amount of protein in the blood and in the amount stored in the fat body granules. Females have more protein in their blood and also store more protein in the granules of the fat body at pupation. The intermoult fat body also sequesters horse radish peroxidase from the haemolymph into granules. These granules are much smaller than those formed at pupation. This sequestration occurs during the period when the blood protein is increasing. The protein sequestered

at this stage is not stored in large granules as at pupation and must therefore be degraded by the cells. This suggests that the fat body is engaged in the turnover of blood proteins. The uptake of the blood proteins during the intermoult is not dependent on the presence of hormones from the head and thorax. "Dauer" larvae, produced by thoracic ligation to prevent moulting, continue to sequester peroxidase from the blood. The cells thus have an intrinsically controlled ability to take up proteins. In contrast, ligation experiments show that the formation of the large granules at pupation occurs only after the action of the moulting hormone. The moulting hormone may influence both the rate of sequestration and the rate of destruction of the protein. Protein uptake is a two stage process. The first step is the concentration of the blood proteins in the intercellular spaces between the fat body cells. These spaces are continuous with intracellular channels formed by the extensive invagination of the plasma membrane. The concentrated protein is then ingested in vacuoles which pinch off from the tips of the intracellular channels. The vacuoles fuse to form granules in which the protein is either lysed or stored, depending on the stage in the moulting cycle. Not all the granules are formed from sequestered blood protein. There is a phase of autolysis before protein sequestration during which mitochondria and a small amount of the endoplasmic reticulum are isolated and lysed. After the sequestration of blood proteins to form the major portion of the granules, a second phase of autolysis occurs. This involves the isolation and partial autolysis of the endoplasmic reticulum. The residual bodies from the two autolytic phases are stored along with the granules of sequestered protein and are probably used by the pupa to provide precursors for adult development. (From DA)

142 Dinamarca, M.L., Levenbook, L. OXIDATION, UTILIZATION, AND INCORPORATION INTO PROTEIN OF ALANINE AND LYSINE DURING METAMORPHOSIS OF THE BLOWFLY Phormia regina (Meigen). Archs Biochem. Biophys. 117, 1 (1966) 110-119.

L-alanine-U-^{14}C (123 mCi/mM) and L-lysine-U-^{14}C (223 mCi/mM) were used. Blowflies at the desired experimental stage were injected quantitatively with 1.0 µl of isotope, the adults into the thorax, the pupae after piercing of the external puparium in the abdominal region lateral to the heart. The extent of alanine and lysine oxidation by various developmental stages of the blowfly is stage specific. Both amino acids are most slowly oxidized at about half way along adult development, but alanine is most rapidly oxidized by the adult fly, and lysine by the white pupa at the commencement of pupation. The rate of utilization (K_a) for free pool alanine is at all corresponding stages higher than for lysine. Variations in K_a-alanine during metamorphosis are far more pronounced than for K_a-lysine, K_a-alanine being particularly high in the white pupa. Alanine and lysine were incorporated into total protein at identical rates (K_p) during metamorphosis except in the mature fly, where K_p-lysine was higher than K_p-alanine. The K_p values, at all times low, decreased markedly during adult development. It is suggested that protein synthesis during blowfly metamorphosis is less extensive than had previously been assumed.

143 Doe, F., Schutin, M., Federbush, M. SYNTHESIS OF RIBOSOMES AND PROTEINS IN THE LARVAE OF Drosophila virilis. J. Cell Biol. 23, 2 (1964) 24A-25A. Abstr. 45. "4th Annual Meeting of the American Society for Cell Biology. Cleveland, Ohio, USA, 11-13 Nov. 1964".

Preparations of ribosomes from D. virilis yield populations of mainly 20S or 80S particles depending on the composition of the isolating media. It has been suggested that the largely protein 20S particles are the structural subunits of 80S ribosomes with which they are antigenically identical. It has now been possible to quantitatively convert 20S particles to 80S ones in vitro (but not vice versa). The in vivo relationship has been pursued by studies of the formation of proteins in the RNP fraction, using sucrose density gradient analyses of ^{14}C-leucine incorporation with an isolating buffer that produces some polysomes, some 20S, and mainly 80S. Long term incorporation (2-4 d) results in an almost equal excess of label in both the 20S and polysome regions when the radioactive peak is normalized to the 80S peak. Chase experiments on cold media after the long term incorporation remove the excess label of the polysomes but not that of the 20S, indicating that the incorporation at the polysome area was transient while that at the 20S was not. Populations were also sampled at various times after exposure to radioactive food. After 2 h, both 20S and polysomes were hot but the 80S area was cold. After 6 h, an 80S radioactive peak commences. At 10 h, the 80S peak can be normalized to the 80S OD peak; the polysomes still have a moderate excess of label and the 20S a large excess. This suggests that synthesis is initiated on 20S and on polysomes, with the 80S labelled secondarily. The constancy of the polysome excess is consistent with a flow of material such as is expected in the site of general protein synthesis. To follow 80S synthesis, a 2 h label was followed by an 8 h chase. The radioactivity showed equal amounts of label in the 20S and 80S regions, approximating the straight

10 h labelling result. This suggests that the label of the 80S ribosomes comes from the hot 20S particles, as if 20S units were the precursors of 80S ribosomes. (Abstr.)

144 Duffy, J.P. BETA ALANINE INCORPORATION INTO INSECT PROTEINS.* Bull. ent. Soc. Am. 13, 3 (1967) 190. Abstr. 57. "New York Meeting of the Entomological Society of America. New York, N.Y., 27-30 Nov. 1967".

Beta alanine incorporation into TCA precipitated proteins of whole body homogenates of T. molitor and Drosophila melanogaster. (Abstr.)

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* Following request (MB) for further information the author sent the abstract below, on β-alanine metabolism in Tenebrio molitor.

"Beta alanine 1-C^{14} metabolism in Tenebrio molitor pupae.

One to four μl of (1-^{14}C) beta alanine (0.5 μCi) was injected into the thoracic dorsum of T. molitor pupae. The radioactive carbon dioxide which resulted from 0-5 h went from 0-3.5% radiation, while the 95% ethanol, 5% TCA whole body precipitate ranged from 3.5-5.0% radiation for the same time intervals. The supernatant that resulted was the most active fraction and ranged from 26-36% radiation with a slight increase in the 5th hour sample. A 24-h sample showed no outstanding increase in radioactive CO_2, or the 95% ethanol, 5% TCA precipitate or supernatant. Paper chromatography of the supernatant established radioactivity entered glutamic acid (92 cpm) and proline (18 cpm) with some residual radioactivity in beta alanine (117 cpm). This supernatant sample was after 24 h. Starch gel electrophoresis of the haemolymph of the T. molitor pupae did not indicate any activity in the four soluble proteins demonstrated by this method."

145 Ellgaard, E.G. GENE ACTIVATION WITHOUT HISTONE ACETYLATION IN Drosophila melanogaster. Science, N.Y. 157 (1967) 1070-1072.

Chromosomal puffing, generally believed to represent gene activation in Drosophila, was induced in the presence of sodium acetate-^{3}H (25 μCi/ml of saline). There is no preferential uptake of these labelled molecules in regions of gene activation. Uridine-^{3}H (25 μCi/ml of saline) was also used. It is concluded from the results of autoradiography that the acetylation of histones does not play a general role in the regulation of RNA synthesis in D. melanogaster.

146 Engels, W. DER ZEITLICHE ABLAUF VON PROTEIN- UND KOHLENHYDRATSYNTHESEN IN DER OOGENESE BEI Apis mellifica L. (The course of protein and carbohydrate synthesis during oogenesis in Apis mellifica L.) p.243-251 of "Verhandlungen der Deutschen Zoologischen Gesellschaft, Jena, 1965". (In German).

The sequence and mutual interaction of protein and carbohydrate syntheses during oogenesis in the honey bee was investigated autoradiographically. A mixture of ^{3}H-D-glucose and ^{3}H-L-histidine was used. By using enzymes to break down polysaccharides and checking against controls it was possible to assess the role played by proteins alone. Protein and glycogen syntheses could therefore be followed in one ovary. Laying 1-yr-old queens were used, and the labelled substances injected abdominally (involving a mixture of equal parts of an aqueous solution of ^{3}H-D-glucose (specific activity 0.45 Ci/mM and ^{3}H-L-histidine (specific activity 1.7 Ci/mM), with 1 μCi/ml total activity). Incubation periods of 5, 10, 30, and 60 min were allowed. Five functional phases could be distinguished, with some overlap in their sequence. They are described in some detail. RNA is transported into the ovum, whereas older oocytes no longer receive newly synthesised RNA. The reduction in RNA supply to the cytoplasm, followed by marked protein synthesis appears to be a first step in certain cytoplasmic maturation processes. Maximal protein synthesis and carbohydrate deposition appear to be mutually exclusive. Reserves of carbohydrates are stored during the final phase.

147 Engels, W. DER ZEITLICHE ABLAUF VON PROTEIN- UND KOHLENHYDRATSYNTHESEN IN DER OOGENESE BEI Apis mellifica L. (The time sequence in protein and carbohydrate synthesis in Apis mellifica.) Zool. Anz., Suppl. 29 (1966) 243-251. (In German)

An aqueous mixture of ^{3}H-D-glucose (specific activity 0.45 Ci/mM) and ^{3}H-L-histidine (specific activity 1.7 Ci/mM), with a total activity each of 1 mCi/ml was injected abdominally into the haemocoel of ovipositing 1-yr old queens. Brief mention is also made of results obtained from using

^{3}H-uridine and ^{3}H-thymidine. Details of the autoradiographic techniques are given. Five functional phases may be distinguished. The 1st, during which there is very limited protein synthesis, is followed by the euplasmatic growth phase which involves prolongued, slowly increasing protein synthesis; the deutoplasmatic growth phase; the 4th phase of oogenesis when carbohydrates are stored in the egg plasma in the form of glycogen, and the 5th and last phase in which the egg is surrounded by the chorion. The hypothesis that maximal protein synthesis and glycogen storage are mutually exclusive appears to fit the Apis-oogenesis data. The results and their significance are discussed.

148 Florkin, M. APPROCHE ORGANISMIQUE ET APPROCHE MOLECULAIRE DANS L' ETUDE DES ADAPTATIONS. SOURCES METABOLIQUES D' UNE SYNTHESE PROTEIQUE ADAPTIVE (COCON DU VER A SOIE). Bull. Acad. r. Belg. Cl. Sci. 51, 5 (1965) 441-463.

Review article drawing on data obtained from work on insects and spiders. A very detailed study has been made of the molecular aspects of the differentiation involved in cocoon spinning in the silkworm. The physical properties of fibroin on which the protective function of the cocoon is based depend on the characteristics of the protein synthesis in the posterior part of the silk gland. The structure of fibroin seems to be explained by the special nature of the messenger RNA liberated at the cellular level in the posterior part of the gland. Detailed analysis has shown, however, that if the nature of the cocoon depends on a specific gene, the formation of the cocoon is the result of several other factors: the type of nutrition available to the silkworm: the behaviour pattern which attracts the silkworm to a specific nutrient, making it chew and finally swallow it, and which leads to the outstanding appetite characterizing the middle of the 5th stage: the way in which amino acids are removed from the haemolymph by the gland: pupal weight control, etc. Differentiation evidently has a clearly polygenic basis which can only be elucidated by a molecular approach. - Radioisotopes were used in the majority of the studies cited.

149 Forrest, H.S., Menaker, M., Alexander, J. STUDIES ON THE PTERIDINES IN THE MILKWEED BUG, Oncopeltus fasciatus (Dallas). J. Insect Physiol. 12 (1966) 1411-1421.

A quantitative re-examination of the pteridines in Oncopeltus has given results at variance with those published previously. The precursors of the red pteridine, erythropterin, are xanthopterin and, probably, oxalacetic acid. The conversion of xanthopterin-8a-^{14}C into erythropterin was studied in 3-5 d old eggs. Xanthopterin is not present as such in Oncopeltus eggs but exists as 7,8-dihydro-xanthopterin. Pyruvic acid-2-^{14}C, on the other hand, proved not to be a precursor of erythropterin. Chrysopterin and biopterin have also been isolated and identified from later growth stages of the bug.

150 Fox, A.S., Kan, J., Kang, S.H., Wallis, B. PROTEIN SYNTHESIS IN CELL-FREE PREPARATIONS FROM Drosophila melanogaster. J. biol. Chem. 240, 5 (1965) 2059-2065.

Uniformly labelled L-leucine-^{14}C, and in some cases L-leucine-^{14}C or L-leucine-^{3}H were used. A cell-free system was developed capable of incorporating ^{14}C-labelled amino acids into protein. The system includes microsomes or ribosomes, soluble RNS (sRNA) or pH 5 fraction, the 20 standard amino acids, ATP and an ATP-generating system, and GTP. Mg ion concentration is optimal at 10^{-2} M. Microsomes and ribosomes exhibit a significant level of endogenous incorporation in the absence of sRNA and pH 5 fraction. sRNA stimulates incorporation more effectively than pH 5 fraction. The requirements for amino acids, ATP, and GTP are not absolute. In the presence of sRNA, the incorporation of 3.20 mμM of L-leucine/mg of microsomal protein/h/μM of L-leucine in an incubation mixture has been observed. This yields an estimate of 8 μg of protein synthesised/mg of microsomal protein. For ribosomes, the corresponding value is 19.83, or an estimate of 52 μg of protein synthesised/mg of ribosomal protein. Ribosomes in 10^{-2} M $MgCl_2$ exhibit a single peak in the ultra-centrifuge with a sedimentation coefficient of 72 S. In 10^{-3} M $MgCl_2$ two peaks are observed at 57 S and 44 S, respectively. Amino acid-activation enzymes are bound to microsomes and ribosomes: no activity has been observed in the soluble fraction, the pH 5 fraction, or the pH 5 supernatant. It is found that tobacco mosaic virus RNA is capable of stimulating incorporation by Drosophila microsomes, apparently functioning as messenger.

151 Fristrom, J.W., Knowles, B.B. STUDIES ON PROTEIN SYNTHESIS IN IMAGINAL DISCS OF Drosophila melanogaster. Expl Cell Res. 47, 1-2 (1967) 97-107.

^{14}C-l-L-leucine (34.1 mCi/mM), ^{3}H-4,5-L-leucine (5.0 Ci/mM), ^{14}C-1-glycine (5.69 mCi/mM), ^{3}H-2-glycine (200 mCi/mM), and ^{3}H-uridine (11.9 Ci/mM) were used in protein determinations. Comparisons were made of protein synthesis in imaginal discs of different developmental stages using

acrylamide gel electrophoresis of ^{3}H- and ^{14}C-labelled protein. No qualitative differences were found between middle 3rd-instar discs and late 3rd-instar discs, and small differences between late 3rd-instar discs and early prepupal discs. Using actinomycin D the functional half-life of mRNA of imaginal discs has been minimally estimated to be ~2½ h long. It is proposed, on the basis of the life of mRNA, that no large differences in the pattern of protein synthesis in late larval and prepupal discs should be expected because the existing mRNA would buffer the system against changes.

152 Fuzeau-Braesch, S. ETUDE DU NOIRCISSEMENT CUTICULAIRE NON-EXUVIAL CHEZ Locusta migratoria. J. Insect Physiol. 12 (1966) 1363-1368.

Secondary of 'homochromic' pigmentation can be induced in adult acridids by rearing the adults on a black background: this occurs in the field when locusts and grasshoppers live on black, burnt land. The secondary pigmentation is achieved in two ways: an epidermal ommochrome appears in certain localized areas within 5-10 d, partially covered by a cuticular pigment. Experiments using ^{14}C-labelled tyrosine show that tyrosine incorporated into the new cuticle before the moult is not a pigment precursor, whereas the tyrosine taken up after ecdysis and during the sclerotization of the cuticle is used for primary pigmentation: the pigment is referred to as 'primary melanin'. The pigment associated with secondary pigmentation appears to have the same nature and origin as the primary pigment, but since it is deposited after the cuticle is sclerotized, it is referred to as 'secondary melanin'. The significance of the secondary melaninization is discussed, as well as the possibility of the hormonal control. (Auth.)

153 Ghosh, D., Forrest, H. S. ENZYMATIC STUDIES ON THE HYDROXYLATION OF KYNURENINE IN Drosophila melanogaster. Genetics 55 (1967) 423-431.

^{3}H-labelled reduced nicotinamide adenine dinucleotide phosphate was used. Kynurenine hydroxylase activity has been detected in wild-type D. melanogaster for the first time. The cinnabar mutant, as expected, lacks this activity, and the white mutant has about one half the wild-type activity. During the life cycle, of the fly, there is a peak of enzyme activity at about the time the brown pigments are being laid down. As in the mammalian system, the enzyme seems to be associated with the "mitochondrial fraction". A theory as to the nature of the biochemical lesion in white mutants is proposed, involving the supposition that kynurenine hydroxylase has a pteridine cofactor.

154 Gruzova, M. N. AUTORADIOGRAPHICAL STUDIES OF PROTEIN METABOLISM IN THE NUCLEI OF OOCYTES OF Panorpa communis. Tsitologiya 9, 1 (1967) 90-92. (In Russian)

Autoradiographic experiments showed that 15 and 60 min after an intravenous injection of leucine-^{3}H and phenylalanine-^{14}C, these amino acids are incorporated mainly into the cytoplasm of P. communis oocytes (polytrophic type) and only slightly into the nucleus. After 24 h the incorporation into the nucleus was twice as high as the incorporation into the cytoplasm. The karyosphere does not demonstrate a specific capacity for preferably binding amino acids, the degree of incorporation is the same as in the rest of the karyoplasm. However, it can be assumed that the karyosphere plays a definite role in the protein metabolism of the nucleus. (CA 66:1967, 102820x)

155 Gumilevskaya, N. A., Kuvaeva, E. B., Chumikina, L. V. C^{14}-GLYCINE AND C^{14}-LEUCINE INCLUSION BY AN ACELLULAR SYSTEM FROM THE SILK GLAND OF Bombyx mori L. Dokl. Akad. Nauk SSSR 174, 2 (1967) 472-476. (In Russian)

The specific activity of 1-^{14}C-glycine was 88-100 mCi/g and that of the labelled ^{14}C-1-leucine was 200 mCi/g. There were no impurities of other ^{14}C-amino acids. The fractions of both free and bound ribosomes of the silk gland were shown to be able to include ^{14}C-leucine in the proteins of the acellular system, whereas glycine can be included only by the bound ribosome fraction (15 000 g-precipitate). In each case the ribosome acellular system from the silk gland of Bombyx mori L. did not differ from the classic systems of animals and bacteria.

156 Hackman, R. H. MELANIN IN AN INSECT, Lucilia cuprina (Wied.). Nature, Lond. 216 (1967) 163.

Melanins are dark pigments usually bound to protein. A culture of the blowfly was used which is homozygous for three recessive mutants carrying yellow eyes, rusty body and a black puparium (in contrast to the brown puparium of the normal wild strain). When empty puparia, from which pupal cuticles, other residues and lipids have been removed, are hydrolysed thin insoluble membranes

remain, "ghosts" of the original pupae, which are colourless in the normal wild strain but intensely black and thicker in the mutant. The black pigment in the puparia showed the physical properties of a melanin, with degradation products characteristic of melanins of animal origin. The pigment was therefore classified as an indole melanin. Experiments with radioactive tyrosine show it to be formed from tyrosine, confirmed by the nature of the degradation products.

157 Harris, S.E., Forrest, H.S. INHIBITION BY CERTAIN PTERIDINES OF RIBOSOMAL RNA AND DNA SYNTHESIS IN DEVELOPING Oncopeltus EGGS. Proc. natn. Acad. Sci. U.S.A. 58, 1 (1967) 89-94.

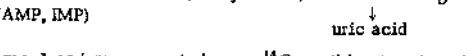
In developing O. fasciatus eggs, in which ribosomal RNA is the major type of RNA synthesised, the rate of this synthesis, when it is at its max., can be affected by incubating partially dechorionated eggs with either of two naturally occurring pteridines, isoxanthopterin, or xanthopterin. Isoxanthopterin and xanthopterin at 10^{-3} M inhibited by 50 or 25%, resp., the incorporation of uridine-^{3}H into ribosomal RNA. DNA sythesis was also affected by the same two compounds. At later stages of development these inhibitory effects disappeared, and indeed, with respect to ribosomal RNA synthesis, pteridines stimulated incorporation of precursor. (CA 67 : 1967, 71415 h)

158 Heslop, J.P. EFFECTS OF AGE ON [^{14}C] VALINE TURNOVER INTO LOCUST WING PROTEINS. Biochem. J. 104, 1 (1967) 5P-6P.

The posterior wings of Schistocerca gregaria age visibly as the animal gets older (see also ref. 136), becoming brittle and breaking away at the ends, although an active circulation of blood is maintained. The turnover of [^{14}C]valine into wing protein 2 h after injection of 0.66 μCi/g live wt. (6.9 mCi/mM; 66 mμCi/μl) has been measured. At adult emergence the wings weigh 70 mg/g live wt. falling quickly to 30 mg/g at 30 h as the wings dry out and tan, and then more slowly to 16 mg/g at 14 weeks old. The wing protein is 10 mg/g at emergence, 6.3 mg/g at 30 h and 3.6 mg/g at 14 weeks so there is no net synthesis of protein by the wings during adult life. 2 h after injection the wings of newly-emerged adults contained 120 μCi/g of wing falling linearly to 53 μCi/g in wings of 14-week-old insects. The rate of incorporation of valine into wing protein was almost linear over the first 4 h after injection. The specific activity of wing protein 2 h after injection was measured in locusts of different ages. The age given is half way through the incubation period: 0.75 h, 0.17 μCi/g; 3.25, 0.28; 5.3, 0.35; 7.5, 0.59; 9.7, 0.61; 15.4, 0.82; 15.2, 1.0; 26.5, 0.95; 31.2, 1.23; 53.4, 1.27; 73, 0.69; 170, 0.67; 338, 0.61; 530, 0.28; 2120, 0.36; 2340 h, 0.29 μCi/g. There was no indication of an increase of protein synthesis in the wings of older insects.

159 Hodge, L.D. PART I. PURINE CATABOLISM IN Drosophila melanogaster. (PART II. URINARY EXCRETION OF UNUSUAL METABOLITES IN IDIOPATHIC ANEMICS.) Diss. Abstr. 27, 8 (1967) 2623-B.

In part I, xanthine dehydrogenase, one of the enzymes of purine catabolism in D. melanogaster, has been extensively studied and is known to be affected by three separate loci. To date little evidence has been presented concerning the remainder of the pathway. In vitro studies were made of a Pacific strain and other strains carrying these mutant genes: w (1-1.5±), bw (2-104±), st (3-44±), lxd (3-33±), ry (3-52±) and ma-l (1-64±).
These conversions of ^{14}C-purines were observed:



Two mutants of XDH, ma-l and ry, converted some ^{14}C-xanthine to uric acid. No evidence for adenine deaminase activity or urate oxidase activity was noted. There was no significant difference in enzymic levels of adenosine deaminase, inosine phosphorylase or guanine deaminase in any of the strains. The possibility of pathway control by the genes involved in xanthine dehydrogenase activity: ma-l (1-64±), ry (3-52±) and lxd (3-33±) was ruled out.

160 Hodge, L.D., Glassman, E. PURINE CATABOLISM IN Drosophila melanogaster. I. REACTIONS LEADING TO XANTHINE DEHYDROGENASE. Biochim. biophys. Acta 149 (1967) 335-343.

The pathway of purine catabolism in larval extracts of D. melanogaster was investigated. The enzymes prior to xanthine dehydrogenase in the pathway appear to be adenosine deaminase, inosine phosphorylase.

and guanine deaminase. Adenine deaminase and urate oxidase are not present in extracts of larvae. A Canton-S wild-type stock strain did not metabolise guanine-^{14}C, suggesting a possible mutation affecting guanine deaminase. Some conversion of xanthine-^{14}C to uric acid was noted in extracts of the xanthine dehydrogenase mutants, ma-1 and ry. (CA 68: 1968, 37150 d)

161 Howells, A.J., Birt, L.M. AMINO ACID-DEPENDENT PYROPHOSPHATE EXCHANGE DURING THE LIFE CYCLE OF THE BLOWFLY Lucilia cuprina. Comp. Biochem. Physiol. 11 (1964) 61-83.

Some biochemical changes during the metamorphosis of the fly L. cuprina were studied and the amounts of free amino acids, soluble protein and DNA per organism have been estimated at different stages of the life cycle. The effect of variations in the concentrations of ATP, pyrophosphate and MG^{2+} on the total rate of amino acid-dependent ATP-pyrophosphate exchange by soluble fractions were investigated and a suitably sensitive method of assay has been derived. Radioactive phosphate, $H_3{}^{32}PO_4$ in HCl, was converted into pyrophosphate by pyrolysis at 400°C for 1 h. Amino-acid-dependent ATP-pyrophosphate exchange was determined by two methods, in both of which $Na_4{}^{32}P_2O_7$ was used.

162 Howells, A.J., Birt, L.M., Finch, L.R. FURTHER STUDIES OF AMINO ACID ACTIVATION DURING THE LIFE CYCLE OF THE BLOWFLY Lucilia cuprina. J. Insect Physiol. 13, 8 (1967) 1221-1236.

A technique has been developed for preparing from the soluble fraction of L. cuprina an enzyme system containing about 80% of the RNA and 25% of the total ATP-pyrophosphate exchange activity of the soluble fraction. 16 different amino acids were able to stimulate exchange with this system. Using this technique, enzymes were prepared from tissues at different stages of the life cycle and the variations during the life cycle in the total ATP-pyrophosphate exchange and in the exchanges with 21 single amino acids were measured. The variations were similar to those obtained with the original soluble fraction. The enzyme system incorporated [^{14}C]-amino acids into a form insoluble in perchloric acid, in a reaction which was dependent on ATP and RNA. Evidence suggested that this reaction included an exchange between amino acids attached to sRNA and [^{14}C]-amino acids in the incubation medium. The incorporations of aspartic acid, glutamic acid, and leucine were highly specific; amino acids with similar chemical structures did not compete effectively. Variations during the life cycle in the extent of incorporation both with a mixture and with single amino acids were investigated. The variations with the mixture of amino acids whether expressed per organism, per mg protein, or RNA were similar to those observed in the total rate of amino acid activation. These results are discussed in relation to likely changes in the rate of protein synthesis during the life cycle. Variations in the extents of incorporation for single amino acids, expressed relative to that obtained with the mixture, occur during the life cycle. Most pronounced were the decreases for glutamic acid and serine and the increases for alanine, aspartic, and tyrosine associated with the transition from larval to pupal life and the changes for leucine, proline, and threonine during the development of the pupa and pharate adult. (Auth.)

163 Hlivicky, J., Agosin, M. GLUTATHIONE TURNOVER IN Triatoma infestans TREATED WITH, 2,2-bis(p-CHLOROPHENYL)-1,1,1-TRICHLOROETHANE. Expl Parasit. 20, 3 (1967) 345-356.

The effect of 2,2-bis (p-chlorophenyl)-1,1,1-trichloroethane (DDT) and 2,2-bis(p-chlorophenyl)-1,1-dichloroethylene (DDE) on ^{14}C-labelled glycine (I) incorporation into glutathione (II) was studied in T. infestans. The levels of glutathione (oxidized) and glutathione (reduced) were similar in nymph and male specimens. DDT increased total II levels in nymphs, but in males this effect was negligible. DDE was without significant effect in nymphs, but markedly decreased total II levels in males. II turnover was increased by DDT in nymphs, whereas the opposite effect occurred in males. DDE markedly increased I incorporation into II in nymphs within the 1st hour of intoxication, but the turnover time was unaltered. These results were attributed to the increased level of enzymes involved in the synthesis and degradation of II. (CA 67: 1967, 116120x)

164 Ivie, G.W., Green, L.R., Dorough, H.W. THE USE OF SODIUM BICARBONATE C^{14} TO DETERMINE CHOLINESTERASE ACTIVITY. Bull. envir. Contam. Toxicol. 2, 1 (1967) 34-40.

Simple and inexpensive methods of determining cholinesterase activity are useful in many phases of research dealing with organophosphorus and carbamate insecticides. Such a method, based on the same principle utilized in manometric techniques has been developed successfully. Sodium bicarbonate-^{14}C is used to react with acetic acid liberated from the enzymatic hydrolysis of acetylcholine. The resulting $^{14}CO_2$ is trapped and quantitatively measured by liquid scintillation counting. The

method is rapid and inexpensive; although so far limited to gross determinations it could be made into a useful tool for more precise studies by additional refinement.

165 Jacobs, M.E. DEPOSITION OF LABELLED BETA-ALANINE IN EBONY AND NON-EBONY Drosophila melanogaster WITH NOTES ON OTHER AMINO ACIDS. Genetics 53 (1966) 777-784.

16 different ^{14}C-labelled amino acids (400 cpm in 10^{-5} ml water) were injected into the haemocoel of early pupae and early adults of the genotypes e, e^+, and e^+/e females. Following β-alanine injection, pupal cases incorporated more ^{14}C in e^+ than in e. The reverse was true for precipitates from centrifuged homogenized adults, and for excreted CO_2 – e showed greater incorporation than e^+, e^+/e was intermediate. With other amino acids, C in pupal cases was near background; however, with γ aminobutyric, aspartic, and glutamic acids and alanine more C was incorporated in e^+ than in e. Rates of $^{14}CO_2$ excretion were the reverse of the C-count of pupal cases and of precipitates of bodies of emerging adults. The β-alanine 2nd carbon was excreted as $^{14}CO_2$ more slowly than was the 1st carbon. With carboxyl labelled β-alanine, phenylalanine, and valine, $^{14}CO_2$ excretion was later in e than in e^+. Centrifuged precipitates from adults homogenized 6 h after injection showed great variation in C. With β-alanine, precipitates had lower counts for e than e^+, while e^+/e was intermediate. Rates of $^{14}CO_2$ excretion of these teneral adults were in reverse order of C in body precipitates. e^+ adults aged 9 d before injection showed accelerated $^{14}CO_2$ excretion and no-C-incorporation in body precipitates. β-alanine was injected into tenerals of other stocks. Oregon-R and two "black" mutants incorporated C in body precipitates at high rates, ebony^{11} did not, and ebony-sooty was intermediate. (Essentially auth. summary)

166 Jenny, E., Hicklin, J.E., Leuthardt, F. IN-VITRO-EINBAU RADIOACTIVER AMINOSÄUREN IN DIE PROTEINE VON Drosophila -PUPPEN. (In vitro incorporation of radioactive amino acids into proteins of Drosophila pupae.) Helv. chim. Acta 45 (1962) 2014-2020. (In German, with English summary)

The incorporation of labelled amino acids (among them ^{14}C-leucine) into microsomes from D. melanogaster pupae is described. Enzymatic incorporation can only be demonstrated after inhibition of a very active tyrosinase which is present in the microsomal fraction, by phenylthiourea. The system has the following properties: (1) It requires ATP, Mg^{++}, an ATP regenerating system, but not GTP. (2) Sucrose-washed microsomes with and without addition of pH 5 enzymes incorporate to the same extent. (3) Microsomes treated with deoxycholate or 0.05 M KCl incorporate less than the untreated ones, the former being nevertheless stimulated by addition of pH 5 enzymes or the pH 5 precipitate of the KCl extract. (4) Rat liver microsomes or pH 5 enzymes can be exchanged with the corresponding fraction from Drosophila.

ATP = adenosine-5'-triphosphoric acid.
GTP = guanosine-5'-triphosphoric acid.

167 Deleted.

168 Kapitza, W. SOME PROPERTIES OF THE NEUROHORMONES C AND D. Věst. čsl. Spol. zool. 31, 4 (1967) 355-359.

Four active substances have been isolated from the central nervous system of insects and crustaceans: acetylcholine, serotonin, and neurohormones C and D. Studies on S metabolism using ^{35}S compounds in Periplaneta americana indicated that neurohormones C and D were of a peptide nature with S-containing amino acids. The neurohormones increased the heart beat frequency in Periplaneta until the heart stopped either in systole (with neurohormone C) or diastole (neurohormone D). The heart inhibition could be removed by diluting the neurohormones with insect Ringer solution. Neurohormone D increased uptake of neutral red dye by Malpighian tubules and intestine of Dixippus morosus, whereas neurohormone C had an inhibitory action. (From CA 68: 1968, 76054v)

169 Karlson, P. BIOCHEMISCHE WIRKUNGSWEISE DER HORMONE. (Biochemical mechanisms of hormone action.) Dt. med. Wschr. 86 (1961) 668-674. (In German)

The effect of hormones on certain enzyme systems in terms of inhibition and activation, the effect on membranes by affecting permeability, and the effect on gene substance by activation or inactivation are discussed critically on hand of various examples. The effect of ecdysone is discussed in

connection with the induction of the puffing phenomenon, investigated autoradiographically in Chironomus tentans.

170 Karlson, P. BIOCHEMISTRY AND MODE OF ACTION OF ECDYSONE. p. 416-419 of "2nd International Congress of Endocrinology. Proceedings. 1964".

Cholesterol-^{14}C had been shown by the author to be a precursor of ecdysone. Ecdysone has been demonstrated to induce moulting and processes preparatory to moulting, and to induce the synthesis of mRNA carrying the information for dopa decarboxylase. The induction of puffs in salivary gland chromosomes and the biochemical events leading to the sclerotization of the larval cuticle are discussed.

171 Karlson, P. ECDYSON, DAS HÄUTUNGSHORMON DER INSEKTEN. (Ecdysone, the moulting hormone of insects.) Naturwissenschaften 53, 18 (1966) 445-453. (In German)

Review article. After a historical survey, the author discusses the concentration and isolation of ecdysone, the elucidation of its structure, its biological and biochemical effects, and its mechanism of action. Radioisotopes, although used in numerous studies cited are not mentioned specifically in the text.

172 Karlson, P., Sekeris, C.E. ECDYSONE, AN INSECT STEROID HORMONE, AND ITS MODE OF ACTION. Recent Prog. Horm. Res. 22 (1966) 473-493.

The chemical, physiological and chemical effects and the mechanism of action of ecdysone are reviewed. It was the first insect hormone to be isolated in pure, crystalline form, and the first to have its structure elucidated. Its mechanism of action, influence on genetic material and induction of messenger RNA synthesis are well documented. The use of radioisotopes formed an essential part of many studies cited (e.g. tracer studies with labelled compounds showed that tyrosine, dopa, and tyramine are incorporated into the cuticle: the stimulation of RNA synthesis, etc.). There are many indications that the same mechanism of action may also be valid for other steroid hormones in mammalian target tissues. (An active discussion on the paper is reported fully: see p. 494-502.).

173 Karlson, P. THE EFFECTS OF ECDYSONE ON GIANT CHROMOSOMES, RNA METABOLISM, AND ENZYME INDUCTION. Mem. Soc. Endocr. No. 15 (1967) 67-74; discussion 74-76.

A review with conclusions. Ecdysone, the moulting hormone of insects, exerts its action at the level of the chromosome and induces messenger-RNA and in turn enzyme synthesis. In this respect hormones appear as general inducers and may be, in higher organisms, of far greater importance than substrates, which are of primary importance to bacteria. (CA 67:1967, 1059w)

174 Kasting, R., McGinnis, A.J. AMINO ACID REQUIREMENTS OF Hypoderma bovis, DETERMINED WITH GLUCOSE-U-^{14}C. Expl Parasit. 19, 3 (1966) 249-253.

Labelled glucose was injected into 3rd-instar larvae of H. bovis, the northern cattle grub, and the concentrations of some of the amino acids in the tissues of the grubs were determined. Alanine, proline, aspartic acid, and glutamic acid were readily synthesised and appeared to be nutritionally non-essential. The absence of radioactivity in phenylalanine, tyrosine, leucine, histidine, lysine, isoleucine, valine, threonine, and methionine showed that they were not synthesised by the cattle grub and were probably essential. Limited synthesis of glycine, serine, and arginine by this insect suggested that it would benefit from a dietary supply of these compounds. (CA 66: 1967, 83577e)

175 Kasting, R., McGinnis, A.J. RADIOISOTOPES AND THE DETERMINATION OF NUTRIENT REQUIREMENTS. Ann. N.Y. Acad. Sci. 139 (1966) 98-107.

An indirect radioactivity method for determining nutrient requirements is described. It depends on the presence of a readily metabolized compound normally available in food and labelled with ^{14}C. Nutrients of interest such as amino acids are subsequently isolated from the organism; after purification, the radioactivity is determined. Substances that contain ^{14}C are considered to be nutritionally non-essential since they were synthesised by the organism. In contrast, those substances that contain no ^{14}C are considered nutritionally essential since they were not synthesised. The validity of the method was established by comparing results with those of the classical deletion procedure. Apparent discrepancies can be explained. The radioactivity method has already been applied to several organisms that cannot be reared on chemically-defined diets. In particular, it has been widely used for determining the amino

acid needs of phytophagous and other insects. Conditions used in determining amino acid requirements of different organisms by the indirect radioactivity method are tabulated and include the black blowfly, Phormia regina, the pine sawfly, Neodiprion pratti Dyar, the wheat stem sawfly, Cephus cinctus, the wireworm Ctenicera destructor, the cutworm Agrotis orthogonia Morr., the warble grub Hypoderma bovis, and the green peach aphid Myzus persicae. The dietary need of the hide beetle, Dermestes vulpines, for cholesterol (and the lack of a dietary requirement for mesoinositol by the rat) were confirmed by the radioactivity method. The amino acid requirements have been examined for a number of other species including Periplaneta americana and Blattella germanica. Factors that must be considered in the interpretation of results from the radioactivity method are (a) purity of isolated compound, (b) pool size and source of isolated compound, (c) radioactive substrate, (d) metabolism period, and (e) administration of radioactive substrate. Radioisotopic procedures have also been used to demonstrate utilization of protein and cellulose by insects. In addition, radioisotope may be used to measure the amounts of food consumed and digestibility of dietary components by small organisms.

176 Kobayashi, M., Akaki, H. ACTION OF ECDYSONE ON SOME METABOLISM DURING LARVAL-PUPAL TRANSFORMATION OF THE HOUSEFLY, Musca domestica L. (DIPTERA: MUSCIDAE). Appl. Ent. Zool. 2, 4 (1967) 223-224.

The effect of ecdysone on DNA and RNA synthesis, and on leucine and glucose metabolism was investigated. 5 µl water (± 2 µg ecdysone) were injected into the posterior half of house fly larva, together with 0.2 µCi of ^{3}H-thymidine, -uridine, -leucine- or -glucose. Most DNA synthesis appears to have been completed 24 h prior to pupation, whereas ecdysone appeared to accelerate RNA synthesis in the tissues examined (epidermis, fat body, muscle) by stimulating RNA-polymerase. Although ecdysone-injected larvae showed some slight incorporation of leucine into the epidermis, muscle, and intestine there was no increase with time, and the incorporation of leucine is not considered to be closely correlated with the presence of the hormone. It appears that injected glucose is converted to polysaccharides or related compounds and stored in the tissue. Ecdysone probably acts on glucose degradation in M. domestica larvae in the way it acts on Samia pupae. (See 99)

177 Kristensen, B.I. INCORPORATION OF TYROSINE INTO THE RUBBER-LIKE CUTICLE OF LOCUSTS STUDIED BY AUTORADIOGRAPHY. J. Insect Physiol. 12, 2 (1966) 173-177.

Incorporation of L-tyrosine, generally labelled with ^{3}H and given as a single injection into the haemolymph of the desert locust, Schistocerca gregaria Forskål, is shown to take less than 6 h, and the lag-phase is less than 1-2 h. The brightly fluorescent bands in resilin are synthesised during the day periods, whereas the faintly fluorescent bands are synthesised during the night periods. It is shown that the part of the prealar arm where two chitin lamellae are missing is synthesised soon after emergence. (Essentially auth.)

178 Kuvaeva, E.B., Gumilevskaya, N.A., Chumikina, L.V., Sisakyan, N.M. INCORPORATION OF AMINO ACIDS INTO PROTEINS OF NONCELLULAR SYSTEM OF Bombyx mori PUPAE. Dokl. Akad. Nauk SSSR 167, 3 (1966) 695-698. (In Russian)

The cell free centrifugates prepared from crushed pupae 1-7 d of age were examined as to their ability to take up ^{14}C-labelled amino acids into their proteins, with tagged alanine, glutamic acid, L-leucine, and threonine being used. Such incorporation was indeed found. Ribosomes isolated during max. level of histolysis had low activity; ribosomes from 7-d pupae had high activity. Amino acid incorporation was impossible in the presence of active tyrosinase. Amino acid incorporation in the cell-free system requires the presence of ATP and is sensitive to RNase and puromycin. (CA 64:1968, 20036g)

179 Deleted.

180 Laufer, H., Nakase, Y. CHROMOSOMAL PUFFING AS AN EXPRESSION OF PROTEIN TRANSPORT BY THE DIPTERAN SALIVARY GLAND. J. Cell Biol. 23, 2 (1964) 52A. Abstr. 103, at "4th Annual Meeting of the American Society for Cell Biology. Cleveland, Ohio, USA, 11-13 Nov. 1964".

The primary function of the salivary gland in Chironomus thummi and C. tentans is to produce a secretion. Puffing of the Balbiani rings on salivary gland chromosomes, which represents sites of heightened RNA synthesis, has often been correlated with the production of secretion (Beermann, Panitz, Laufer). The pattern of Balbiani ring puffing is tissue and stage specific, as is the production of the secretion. Quantitative biochemical and immunochemical analyses of the salivary secretion revealed the presence

of a number of enzymes (Laufer) and antigens. Recently we found that all the major secretions antigens and enzymes occurred in other tissues as well as in the blood. Thus an apparent paradox arose: tissue- and stage-specific puffs appeared to be related to the secretion of proteins (representing more than 50% of the secretory mass), yet these proteins were not tissue specific. The following experiments appear to resolve this paradox. They indicate that salivary glands function predominantly to select, concentrate, and particularly to transport the proteins of the secretion. Furthermore, present evidence indicates that the gland does not synthesise any of the major secretory proteins. ^{14}C-labelled Chironomus blood proteins were injected into larvae. Radioactive proteins promptly appeared in the secretion. Radioautographs of tissue sections showed that the radioactivity was located in cytoplasmic granules; these granules seemed to be formed at the ends of canals connected to the basal surface of the gland. Uptake of proteins therefore appears to occur from the haemolymph by a process akin to pinocytosis. After the injection of radioactive human serum albumin into larvae, this heterologous protein also was recovered in the secretion, retaining its antigenic properties. We concluded that the major proteins and antigens of the secretion normally are derived from the blood. Since the presence of the Balbiani rings in salivary chromosomes is correlated with the secretory process, we suggest that the Balbiani rings reflect the functioning of genes concerned with the synthesis of special "transport" proteins, or "permeases," important in the secretory process. These substances would not appear to be major constituents of the secretion itself. Thus the non-specific secretion even of heterologous protein can be, and indeed seems to be, mediated by tissue-specific puffs. (Abstr.)

181 Laufer, H., Doyle, D. SOURCES OF SALIVARY GLAND SECRETION IN Chironomus tentans. J. Cell Biol. 31, 2 (1966) 66A. Abstracts of Papers Presented at the "6th Annual Meeting of the American Society for Cell Biology, Houston, Tex., USA. 17-19 Nov. 1966". Abstr. 131.

Most proteins found in extracts of isolated salivary glands were also present in the haemolymph, according to results with disc electrophoresis in acrylamide gels. Certain blood proteins were labelled in the absence of the salivary glands when ^{14}C-amino acids were injected into the body cavity. These blood constituents are identical with proteins of the salivary secretion, since the same number of counts were precipitated from labelled blood by antibodies to either secretion or blood. The transport of protein from the haemolymph to secretion can be demonstrated by ^{125}I-serum albumin injection into the haemocoel. Labelled protein appeared in the secretion as demonstrated by the recovery of substantial quantities of albumin from the secretion and by high resolution radioautography of sectioned glands. Albumin transfer was not diminished by concomitant injections of iodine or tyrosine. These observations are consistent with a salivary gland transport function and suggest that blood components are synthesised at sites other than the gland, being subsequently transferred by the gland to the secretion. In addition to those components of the secretion which are concentrated by the gland, some fraction of the secretion is also synthesised in situ by the salivary gland. This was revealed by radioautographic analysis of glands cultured in vitro with a pulse of ^{3}H-lysine followed by a chase with the unlabelled amino acid. Labelled protein studies indicate that phosphoproteins have a function in the nucleus. The fact that purified nuclear phosphoprotein forms complexes with histones which are less inhibitory to DNA-dependent RNA synthesis than free histones (Langan, in Symposium on "Regulatory Mechanisms in Nucleic Acid and Protein Biosynthesis", Biochim. et Biophysica Acta, Library Ser., 1966, in press) suggests the possibility that phosphoproteins may be involved in the regulation of RNA synthesis in eukaryotic chromosomes. (From abstr.)

182 Laufer, W. BEITRÄGE ZUR STRUKTUR DES SKLEROTINS UND ZUM CHEMISMUS DER SKLEROTISIERUNG. (Contributions on the structure of sclerotin and the chemistry of sclerotization.) Thesis. Munich Univ. (West Germany). Naturwissenschaftliche Fakultät. 1964, 70p. (In German)

The structural composition and histological differentiation of Diptera cuticles before and after pupation, followed by hormonal control, and chinone tanning under the action of phenol oxydase systems are discussed. The particular aspects studied were the changes in the chemical structure of cuticula by sclerotization, attention being paid to the fate, distribution and compound formation of tyrosine metabolites in the cuticle during different developmental stages; and the incorporation of various labelled precursors of chinone into the cuticula. Labelled amino acids (generally labelled L-tyrosine, α-^{14}C-DL-tyrosine, α-^{14}C-DL-DOPA, 2,3,5,6-^{14}C-hydrochinone, 1-^{14}C-leucine, α-^{14}C-dopamine, acetyl dopamine, acetyl dopamine-α-^{14}C, acetyl-^{14}C dopamine, and generally labelled acetyl tyramine) were injected into larvae 1 d before pupation, and the distribution of radioactivity between cocoon and pupa determined. Tyrosine incorporation does not involve protein synthesis. Phenolic rather than chinoid substances appear responsible for cuticle tanning. Tyrosine is

incorporated primarily during the first 24 h of pupation, at a percentage considerably above that of dopamine. - During pupation the water content of the cuticula drops from 68% to 7%. The increase in dry weight by 31% is caused by the sclerotizing substance acetyl dopamine, by an unidentified carbohydrate, and a further protein. The chitin content remains unchanged. Experiments with ^{14}C-tyrosine have shown that tyrosine metabolites are firmly incorporated into the cuticula in the course of sclerotization. Apart from tyrosine, N-acetyl-dopamine, a direct precursor of sclerotizing chinone, was found in the cuticula of prepupae. In 12-h-old, just coloured puparia no N-acetyl-dopamine or radioactive tyrosine can be traced even after extraction and hydrolysis. The presence of phenols and phenol carbonic acids has, in part, been confirmed in Calliphora. They are not, however, formed from tyrosine immediately before pupation. Para-diphenols do not play any part in sclerotization. Fractionated chemical extraction of puparia gave fractions particularly enriched in labelled tyrosine metabolites, the fractions containing only 15% protein. The major component consists of what is presumably a carbohydrate with markedly high O-content. The protein which lacks arginine, serine, and threonine can be separated completely by hydrolysis. Radioactivity remains in the carbohydrate fraction. When extracts are hydroxylated before hydrolysis, 4 ninhydrin-negative degradation products are obtained. The radioactive C_4-chain proves that a chinoid metabolite is involved in sclerotization. From the various data obtained the author concludes that the chinoid tyrosine metabolite is responsible for the reddish brown colour, the incorporation of the cuticle components as a network within the complex sclerotin structure, and probably also for linking them to the chitin skeleton.

183 Liaci, L. SYNTHESIS OF SEPIAPTERINE FROM LABELLED ADENINE IN THE EYES OF Drosophila melanogaster. Riv. Biol., Suppl. 58 (1965) 53-55.

The title synthesis in the mutant se was determined by chromatography and autoradiography. A purine base was utilised, in this case, adenine. (CA 64: 1966, 14647g)

184 Linzen, B., Ishiguro, I. 3-HYDROXYKYNURENINE IN Bombyx mori. NEW TRYPTOPHAN METABOLITE, 3-HYDROXYKYNURENINE GLUCOSIDE. Z. Naturf. 21b, 2 (1966) 132-137.

Using a specific quantitative method, 3-hydroxykynurenine was determined through a number of larval, pupal and imaginal stages of the B. mori mutant rb. There is a steady increase in the amount of hydroxykynurenine from the spinning larva to the middle of the pupal stage, reaching 1 mg/animal. During the same period the pattern of fluorescent compounds shows significant changes. After injection of ^{3}H-hydroxykynurenine several fluorescent compounds are labelled. The O-ß-glucoside of 3-hydroxykynurenine appeared after cocoon spinning. Its structure was confirmed by synthesis. (CA 64: 1966, 18077a)

185 Linzen, B. ÜBER NEUE OMMOCHROME BEI HEUSCHRECKEN. (The existence of new ommochromes in grasshopper.) Naturw. Rdsch., Stuttg. 12 (1959) 432. (In German). Also presented at "17. Internationaler Kongress für Reine und Angewandte Chemie 30 Aug. - 6 Sep. 1959."

The existence of ommochromes in grasshopper was investigated. The brick-red pigment was isolated from the eyes. Compared with the usual ommochromes the isolated pigment showed different characteristics on analysis by paper chromatography and spectroscopy. It could, nevertheless, be identified as an ommochrome by means of experiments involving the injection of ^{14}C-tryptophan into larvae.

186 Linzen, B. ZUR BIOCHEMIE DER OMMOCHROME. UNTERTEILUNG, VORKOMMEN, BIOSYNTHESE UND PHYSIOLOGISCHE ZUSAMMENHÄNGE. (The biochemistry of ommochromes. Their subdivision, occurrence, biosynthesis, and physiological significance.) Naturwissenschaften 54, 11 (1967) 259-267. (In German)

Work on the dark eye pigments of insects is reviewed. Some radioisotope studies are cited. Thus the red pigmentation in the eye of certain grasshoppers (variously called acridioxanthine, acridioerythrine and insectorubine) could be proved, by means of its incorporation of radioactive 3-hydroxykynurenine, to be of ommochrome, rather than of ommine nature. The term ommidine was subsequently used for it. - The incorporation of labelled precursors into ommines was demonstrated by means of methionine-^{35}S and 3-hydroxykynurenine-^{3}H into Gryllus bimaculatus. It could thus be shown that the ommines are not synthesised continuously but only for a short period at the end of each moult.

187 Locke, M., Collins, J.V. SEQUESTRATION OF PROTEIN BY THE FAT BODY OF AN INSECT. Nature, Lond. 210 (1966) 552-553.

Two hours after the injection of ^{3}H-tyrosine (20 μCi/g) into 28 Calpodes larvae in the 5th and pupal stadia, autoradiographs demonstrated that amino acid incorporation into the fat body was no higher at the time of protein granule formation than at other times in the stadium. In contrast, there was considerable incorporation into the epidermis when the protein granules were forming and the endocuticle was being resorbed, but the protein granules did not have a higher labelled amino acid incorporation than did the rest of the cell. The incorporation of ^{3}H-leucine was also examined. Treatment of the larvae with a foreign recognizable protein (horseradish peroxidase) when the protein granules were forming demonstrated, in frozen sections treated with alcoholic benzidine-HCl, that the protein granules may have resulted from the fusion of smaller granules, suggesting that the fat body sequesters proteins from the blood to form the protein storage granules.

188 Lue, P.F., Dixon, S.E. STUDIES OF THE MODE OF ACTION OF ROYAL JELLY IN HONEYBEE DEVELOPMENT: THE UTILIZATION OF SUGAR UNIFORMLY LABELLED WITH ^{14}C AND OF ASPARTIC-1-^{14}C ACID. Can. J. Zool. 45 (1967) 595-599.

The amino acid requirements of developing honey bee larvae were determined by the indirect method using glucose-U-^{14}C and sucrose-U-^{14}C. The amino acids proline, hydroxyproline, alanine, glutamine, glutamic acid, α-amino-n-butyric acid, γ-amino-n-butyric acid, glycine, serine, and β-alanine were classified as non-essential. Cystine, aspartic acid, asparagine, isoleucine, leucine, phenylalanine, methionine, tryptophan, valine, threonine, tyrosine, lysine, histidine, and arginine were considered to be essential. The metabolism of sugar and aspartic acid are discussed in relation to caste development. (Auth.)

189 Mansingh, A. METABOLISM OF LABELED GLUTAMIC ACID IN ADULT GERMAN COCKROACHES. J. econ. Ent. 59, 1 (1966) 234-235.

Some aspects of the fate and metabolic pathways of the carbon skeleton of glutamic acid are considered. (U-^{14}C)-glutamic acid in distilled water was injected into the body cavity of Blattella germanica (L.), the radioactivity of the solution being 0.01 mCi or ~ 2500 cpm. The final values were corrected for self absorption and back counts. The recovery of radioactivity from $^{14}CO_2$, sugars, lipids, and some of the amino acids suggests that the bulk of the administered amino acid was metabolized via Krebs' TCA cycle. The labelled carbon of glutamic acid was found to be incorporated into seven amino acids, proline, glutamine and glycine showing much higher radioactivity. The incorporation of (U-^{14}C)-glutamic acid into various compounds is tabulated and the significance of the results discussed.

190 Meinwald, J., Koch, K.F., Rogers, J.E., Jr., Eisner, T. BIOSYNTHESIS OF ARTHROPOD SECRETIONS III. SYNTHESIS OF SIMPLE p-BENZOQUINONES IN A BEETLE (Eleodes longicollis). J. Am. chem. Soc. 88, 7 (1966) 1590-1592.

Two pathways of synthesis of the p-benzoquinones found in arthropod defence secretions were demonstrated in E. longicollis. Paper chromatography of 2,4-dinitrophenylhydrazine-treated secretions from L-tyrosine-U-^{14}C or DL-phenylalanine-ring-^{14}C-fed insects showed the synthesis of p-benzoquinone to involve the utilization of the aromatic ring of tyrosine or phenylalanine. Direct silicic acid column chromatography of secretions from insects injected with Na acetate-1-^{13}C and Na propionate-1-^{14}C gave component benzoquinones which were oxidized to acetic and propionic acid by $KMnO_4$. The aliphatic acids were degraded by the Schmidt reaction and the products purified to a constant specific activity. About 30% of the total activity of methyl-p-benzoquinone derived from Na acetate-1-^{14}C appeared at C-2. Since < 0.1% of the activity occurred in the Me group of this compound, the remaining 70% must be distributed among the other 5 ring-C atoms. Similarly, with ethyl-p-benzoquinone derived from Na acetate-1-^{14}C, about 90% of the total activity was found in the analogous 5 ring-C atoms. Thus, the synthesis of methyl-p-benzoquinone and ethyl-p-benzoquinone involved the utilization of acetate units to form the quinone ring. After injection of Na propionate-1-^{14}C, 95% of the activity found in ethyl-p-benzoquinone was recovered in the derived propionic acid and was almost entirely localized at C-2 of the ring. The low level of incorporation of the precursor into the remaining ring C of methyl-p-benzoquinone and ethyl-p-benzoquinone may be due to the slight conversion of the precursor into C_2 units. (CA 65: 1968, 2693b)

191 Melius, M.E., Jr. AN AUTORADIOGRAPHIC ANALYSIS OF BLOOD PROTEIN UPTAKE AND PROTEIN YOLK SPHERE FORMATION BY Cecropia MOTH OOCYTES. Diss. Abstr. 27, 5 (1966) 1659-B.

Cecropia moth oocytes selectively remove proteins from the blood during the period of yolk formation; the blood proteins reach the surface of the oocyte by an intercellular route, enter the oocyte by pinocytosis, and become a component of the protein yolk spheres. The extent to which a particular protein enters the oocyte may be determined by its relative affinity for the surface of the oocyte; three basement lamellae that form continuous boundaries between the oocytes and the haemocoel are also candidates for the site of a selective mechanism. The primary objective of the work described in this dissertation was to obtain experimental evidence concerning the relative contributions of the basement lamellae and the oocyte itself to the selectivity of blood protein uptake. An autoradiographic analysis of the uptake of ^{3}H-blood proteins injected into the haemocoel indicated that selective transmission through the basement lamellae and selective adsorption onto the oocyte surface both contribute to the selectivity of blood protein uptake. Evidence is presented, too, from studies of the incorporation of ^{3}H-leucine into blood proteins and yolk, that the ovary itself synthesises some of the proteins deposited in the yolk spheres. Information concerning the relative rates of yolk formation by various regions of the oocyte cortex was also obtained; the rate of yolk formation by a particular area of the oocyte surface appears to be correlated with the ease with which materials derived from the blood can reach it. (DA)

192 Miles, P.W. STUDIES ON THE SALIVARY PHYSIOLOGY OF PLANT-BUGS: TRANSPORT FROM HAEMOLYMPH TO SALIVA. J. Insect Physiol. 13, 12 (1967) 1787-1801.

The insects used in Australia were 5th-instar larvae of Eumecopus punctiventris Stål (Pentatomidae) collected from under the bark of sugar gums (Eucalyptus cladocalyx F. Muell.); and adults of the peanut litter bug, Elasmolomus sordidus (F.) (Lygaeidae), from a laboratory culture maintained on peanuts. When injected into the haemolymph, D-glucose (universally ^{14}C-labelled), glycerol-1-^{14}C, and amino acids [DL-phenyl (alanine-1-^{14}C), DL-tryptophan (methylene-^{14}C), and D-tryptophan (methylene-^{14}C)], rapidly appear in the watery saliva of phytophagous Heteroptera: Pentatomorphia; and glucose, glycerol, and some amino acids are also incorporated into the precursor of the component of the saliva that solidifies to form the 'stylet sheath'. Injection of a large amount of an amino acid into the haemolymph also causes the compound to appear in unusual concentration in the watery saliva, apparently due to excretory activity by the accessory gland of the salivary apparatus. Radioisotopic and chromatographic evidence is given for the occurrence in the various salivary secretions of carbohydrate and amino- and phospholipid.

193 Miles, P.W., Lloyd, J. SYNTHESIS OF A PLANT HORMONE BY THE SALIVARY APPARATUS OF PLANT-SUCKING HEMIPTERA. Nature, Lond. 213 (1967) 801-802.

A number of experiments were carried out to test the possible synthesis of salivary β-indolyl acetic acid (IAA) in Hemiptera, using Eumecopus punctiventris Stål (Pentatomidae) and Elasmolomus sordidus (F.). Injection of 1.5 μCi of DL-3-phenyl (alanine-1-^{14}C) in 3μl of Martignoni and Scallion's salt solution (without ascorbic acid) into the haemolymph of larvae of Eumecopus at the 5th instar resulted in the appearance in the salivary glands, 1-1½ h later, of subequal quantities of labelled phenylalanine and other radioactive compounds with the same R_f as dihydroxyphenylalanine (DOPA). Results support an earlier suggestion that DOPA is the substrate for the salivary polyphenol oxidase, and indicates that phenylalanine is a precursor. Further experiments were done with the much smaller Elasmolomus. In another experiment, Dl-tryptophan (methylene-^{14}C), in 0.5 μl salt solution containing 2 μg L-phenylalanine (unlabelled), was injected. Autoradiography showed that in the homogenate of the salivary glands (including the accessory gland and ducts), a small amount of the tryptophan had been converted to a labelled compound with the same R_f as IAA. Chromatography of the haemolymph of untreated insects showed that free tryptophan and phenylalanine are normal constituents; IAA synthesis is considered to occur naturally during salivation of these insects.

194 Minks, A.K. BIOCHEMICAL ASPECTS OF JUVENILE HORMONE ACTION IN THE ADULT Locusta migratoria. Archs. néerl. Zool. 17, 2 (1967) 175-257.

An extensive report is given of the biochemistry of juvenile hormone action in the adult L. migratoria, including respiration experiments, experiments with radioactive compounds, agar-gel electrophoresis of proteins, and electron micrography. The role of juvenile hormone in respiratory metabolism is discussed, and a comparative study of the effects of allatectomy and some other operations is presented. The results are in accord with the concept that the fat body produces a considerable fraction of the proteins required for oogenesis, and with the ideas of K.C. Highnam et al. (J. Ins. Physiol. 9: 1963, 587) that the neurosecretory cells activate protein synthesis in the fat body. However, a more independent role is suggested

for the corpora allata in this process. The data are more in accord with the idea that juvenile hormone exerts its activities in the presence of active protein synthesis and induces the formation of specific vitellogenic proteins. The change of lipid and glycogen metabolism in the fat body may be explained in the same way. (CA 68: 1968, 1150q)

195 Muramatsu, M., Otomo, K., Shimura, K. THE BIOSYNTHESIS OF GLYCINE IN THE SILKWORM. III. FORMATION OF GLYCINE FROM GLYCOLIC-^{14}C ACID AND THE OCCURRENCE OF GLYCOLATE OXIDASE. Seikagaku Zasshi (J. Biochem., Tokyo) 59, 3 (1966) 304-309. (In English)

^{14}C-labelled glycolate was converted to labelled glycine in the silkworm in vivo. Less, but significant amounts of serine and alanine were also formed. Glycolate oxidase activity was found in the homogenate of silkworm fat body. Other tissues, such as silkglands and digestive tracts, showed no detectable enzyme activity. An enzyme system from the fat body also catalysed the conversion of glycolate to α-ketoglutarate and pyruvate. Glycolate oxidase activity was stimulated about 2-fold by the addition of 5 × 10^{-4} M NH_2OH to the system, while the formation of α-ketoglutarate was significantly inhibited. (CA 65: 1966, 1093e)

196 Nishizawa, T. FIBROIN SYNTHESIS OF POSTERIOR SILK GLANDS. VII. FIBROUS NUCLEIC ACID IN THE FIFTH INSTAR LARVAE. Seikagaku 38 (1966) 224-233. (In Japanese)

From posterior silk glands of silkworm (Bombyx mori) at the 5th-instar larval stage, fibrous nucleic acid preparation was isolated, consisting mostly of RNA and a slight amount of DNA. It was speculated from analytical data that DNA and RNA make up a complex in this nucleic acid preparation. Actinomycin inhibited the synthesis of this specific nucleic acid, which stimulated the incorporation of glycerine-^{14}C into protein using the supernatant fraction obtained by centrifugation at 105 000 g for 60 min. (CA 65: 1966, 9405g)

197 Norman, C. QUANTITATIVE STUDY OF DISTRIBUTION OF SULFHYDRYL GROUPS IN THE DEVELOPING GRASSHOPPER (Melanoplus differentialis) EMBRYO. Physiol. Zoöl. 27 (1954) 141-156.

The distribution of sulphhydryl groups was studied quantitatively in the grasshopper egg which, during the course of its development, goes into a mitotically blocked or diapause state in which metabolic and other cellular activities are greatly diminished. In one series of experiments, 4-d-old eggs were irradiated at 130 kV, at 125 R/min for 6 min (total dose 750 R), incubated at 25°C and subsequently lots were removed for amperometric analyses. The dose prevents embryo development. The curve representing the yolk -SH of irradiated eggs (without embryos) maintains a fairly constant level of -SH content from the 10th day of prediapause to the 6th day of diapause. This level of -SH is comparable to that found in normal zero-day prediapause eggs. The yolk -SH curve for the controls (with embryos) shows a progressive decrease in the number of titratable sulphhydryl groups. Nonprotein yolk extracts of irradiated as well as control eggs, when treated with 10-15 mg of sodium borohydride for 30 min at room temperature and titrated amperometrically, gave negative results. This indicates the absence of oxidized as well as reduced soluble free mercapto groups in the yolk. Summarizing it may be concluded that: The increase of titratable -SH groups in prediapause, a levelling-off during diapause, and the resumption of a rapid rise in the postdiapause period parallel the metabolic, mitotic, and morphogenetic activity of the embryo during these phases of development. The increase of embryo -SH occurs at the expense of the yolk -SH. There is no direct relationship between the sulphhydryl content and the "blocked" or diapause state in the grasshopper embryo. The excessive, abrupt rise in the titer of -SH groups during postdiapause is associated with morphogenetic growth and differentiation. The embryo is probably the site of origin of the enzyme responsible for the breakdown of protein -SH in the yolk. The nonprotein -SH (probably glutathione) enters the embryonic cells, serving as a substrate for protein -SH resynthesis, as well as acting as a regulator of cell metabolism. Cytoplasmic -SH consists of protein and nonprotein thiols, with all the non-protein -SH in the reduced state. The yolk and nuclei do not contain oxidized or reduced soluble free thiol groups. The histochemical demonstration of protein-bound -SH in the embryo qualitatively confirms the quantitative data and indicates the localization of protein-bound mercaptans in nerve and muscle tissue of postdiapause embryos.

198 Okada, T., Goto, M. SYNTHESIS OF 2-AMINO-4-HYDROXY-6-HYDROXYMETHYLPTERIDINE-10-C^{14} AND 2-AMINO-4-HYDROXYPTERIDINE-10-C^{14} AND THEIR METABOLISM IN Drosophila melanogaster. Seikagaku Zasshi (J. Biochem., Tokyo) 58, 5 (1965) 458-462.

The biosynthesis of sepiapterin by D. melanogaster, mutant sepia, was investigated with 2-amino-4-hydroxy-6-hydroxymethylpteridine-10-^{14}C and reduced 2-amino-4-hydroxypteridine-10-^{14}C. It was found that after growth with both labelled compounds radioactive isoxanthopterin and sepiapterin could be isolated by paper chromatography from the adult flies. The postulated hypothesis concerning the biosynthesis of Drosophila pteridines was thus proved to be correct. (From auth. summ.)

199 Passama-Willaume, M., Barbier, M. SUR LA BIOSYNTHESE DE LA BILIVERDINE IXα PAR LA MANTE Mantis religiosa ET LE CRIQUET Locusta migratoria. C.r. hebd. Séanc. Acad. Sci., D 263 (1966) 924-925.

Glycocoll-1,2-$^{14}C_2$, dissolved in Ringer solution, was injected in the 4th abdominal ring of green larvae of M. religiosa and L. migratoria; after 32 h and 72 h, respectively, larvae were killed in dry ice; green pigments were extracted with water and Me esters were prepared after lyophilization of these extracts. Chromatographic study shows that the injected glycocoll-1,2-$^{14}C_2$ is incorporated in the biliverdin, which is the hypodermal and blood pigment of these two species. (CA 66: 1967, 17350z)

200 Pettit, B.J., Rasch, R.W. TRITIUM-LABELED HISTIDINE INCORPORATION INTO GIANT SALIVARY CHROMOSOMES. J. Cell Biol. 23, 2 (1964) 73A. Abstr. 148, at "4th Annual Meeting of the American Society for Cell Biology, Cleveland, Ohio, USA, 11-13 Nov. 1964".

The role of protein synthesis in the structure of giant chromosomes was followed by feeding ^{3}H-labelled histidine to larvae for a 2-h period 24 - 48 h before puparium formation. The pattern of incorporation into chromosome "puffs" was followed by incubation of explanted Drosophila salivary glands in a Ringer's solution containing the ^{3}H-labelled amino acid. Following a short exposure to the isotope, one lobe of the gland was fixed immediately, as a control, while the other lobe was incubated in "cold" medium for periods up to 2 h. The "developmental stage" of the larva was determined by the number of hours that had elapsed from the sealing of the operculum to the time of explantation. The incorporated isotope was visualized by the application of autoradiographic stripping film to chromosome smears. The autoradiographic patterns of incorporation will be presented and discussed. (Abstr.)

201 Pettit, B.J., Rasch, R.W. TRITIATED HISTIDINE INCORPORATION INTO Drosophila, Drosophila virilis, SALIVARY CHROMOSOMES. J. cell.comp. Physiol. 68, 3 (1966) 325-333.

An autoradiographic study of ^{3}H-histidine incorporation into non-histone protein of explanted larval salivary gland chromosomes of D. virilis showed patterns of incorporation that were dependent upon the stage of larval development. The sequence of changes in the development of several puffs in a specific chromosomal region was followed using the appearance of pigment in the anterior spiracles as a means of larval staging. ^{3}H-histidine incorporation into these puffs in prepupae occurred as the puffs were regressing in size and protein staining. Acid extraction of histone and nucleic acid failed to alter the character of the autographs; presumably a non-histone protein is involved in the ^{3}H-histidine incorporation. Other puff sites in the same prepupal chromosomes showed various patterns of isotopic amino acid incorporation indicating that the pattern reported for a specific region may not be true for all puff sites. (Auth.)

202 Porembska, Z., Gorzkowski, B., Jezewska, M.M. UTILIZATION OF OROTATE-^{14}C IN THE BIOSYNTHESIS OF PYRIMIDINES IN Helix pomatia AND Celerio euphorbia. Acta biochim. pol. 13 (1966) 107-111.

An attempt was made to ascertain whether orotate can serve as precursor for synthesis of pyrimidine nucleotides in those uricotelic invertebrates in which so far the presence of carbamoylphosphate synthase has not been demonstrated. After injection of radioactive orotate to C. euphorbia pupae, active UMP* and CMP** were found in RNA isolated from the fat body and muscle. In RNA from H. pomatia hepatopancreas, radioactive UMP and CMP were found after administration of labelled orotate, aspartate, or bicarbonate. The presence of aspartate carbamoyltransferase in snail hepatopancreas was demonstrated. In the two invertebrates studied, the biosynthesis of the pyrimidine ring probably follows the same pathway as in vertebrates. (CA 65: 1966, 11018h)

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* uridine monophosphate.

** cytosine monophosphate.

203 Price, G.M. THE IN VITRO INCORPORATION OF [U-^{14}C] VALINE INTO FAT BODY PROTEIN OF THE LARVA OF THE BLOWFLY, Calliphora erythrocephala. J. Insect Physiol. 12 (1966) 731-740.

The incorporation of [U-^{14}C] L-valine into fat body isolated from the larva of the blowfly, C. erythrocephala, has been studied in vitro. The effect of various concentrations of L-valine and of a mixture of amino acids was studied at pH 6.5. The highest incorporation rates were obtained with fat body isolated from 4-d-old larvae, the rate falling off rapidly as the larvae became older. It was found that the fat body synthesised protein which was then released into the surrounding incubation medium. During the course of incubation the specific activity of this released protein increased rapidly until its level was many times that of the structural protein of the fat body. (Auth.)

204 Price, G.M., Bosman, T. THE ELECTROPHORETIC SEPARATION OF PROTEINS ISOLATED FROM THE LARVA OF THE BLOWFLY, Calliphora erythrocephala. J. Insect Physiol. 12 (1966) 741-745.

The proteins in the haemolymph isolated from blowfly larvae of different ages were separated by electrophoresis on acrylamide gel. Their pattern was compared with that of proteins released in vitro by blowfly fat body and found to be almost identical. Fat body was also incubated in the presence of [U-^{14}C] valine, and the distribution of ^{14}C-activity among the labelled proteins was measured. (Auth.)

205 Price, G.M. THE EFFECT OF DIFFERENT IONS ON THE INCORPORATION OF [U-^{14}C] VALINE INTO FAT BODY PROTEIN OF THE LARVA OF THE BLOWFLY, Calliphora erythrocephala. J. Insect Physiol. 13 (1967) 69-79.

Fat body from blowfly larvae was incubated with a mixture of amino acids, [U-^{14}C] valine and various Ringer's solutions. The metabolism of phenylalanine was further examined by incubating fat bodies in the presence of [U-^{14}C] phenylalanine. Incorporation of [U-^{14}C] valine into protein was considerably affected by changes in the level of Ca, Mg, K, and Na in the incubation medium. During 60 min incubation there was a fall in the levels of alanine, aspartate, glutamate, and phenylalanine in the medium and a rise in glutamine and tyrosine. An examination of the in vivo distribution of free amino acids between various tissues of the larva showed that aspartate and glutamate were concentrated in tissues other than the haemolymph and that phenylalanine and tyrosine were concentrated in the fat body in particular.

206 Rao, D.R., Ennor, A.H., Thorpe, B. THE ISOLATION AND IDENTIFICATION OF L-LANTHIONINE AND L-CYSTATHIONINE FROM INSECT HEMOLYMPH. Biochemistry 6, 4 (1967) 1208-1216.

Lanthionine and cystathionine have been isolated in crystalline form from the deproteinized haemolymph of Bombyx mori (silkworm) and Antheraea pernyi (Japanese oak moth) by ion-exchange chromatography. Both compounds have been characterized as the L-enanthiomorphs by enzymic and physical methods. A preliminary survey of the distribution of lanthanine and cystathionine throughout a number of phyla has been carried out and the results of this, together with some preliminary experiments on the in vivo incorporation of isotopically labelled materials, is reported. The presence of free L-lanthionine in insect tissues is invariably associated with a complete absence or, at the best, barely detectable traces of cysteine, cystine, and methionine. (Auth.)

L-[^{35}S] cystine, L-[^{35}S] methionine, and L-[3-^{14}C] serine were used.

207 Ray, J.W. THE FREE AMINO ACID POOL OF COCKROACH (Periplaneta americana) CENTRAL NERVOUS SYSTEM. p.31-38 of "The Physiology of the Insect Central Nervous System". Treherne, J.E., Beament, J.W.L., Eds. 1965.

208 Razet, P. END PRODUCTS OF NITROGEN CATABOLISM IN INSECTS. Année Biol. 5 (1-2) (1966) 43-73.

A review of the origin and fate of uric acid, degradation of nucleic acids, nonuric acid N excretion, urea, ammonia, amino acids, creatine, creatinine, and pteridines.

209 Rembold, H. ZUM STOFFWECHSEL DES BIOPTERINS IN DER HONIGBIENE. (Biopterin metabolism in the honey bee.) Naturw. Rdsch., Stuttg. 12, 11/12 (1959) 432-433. (In German) Also presented at "17. Internationaler Kongress für Reine und Angewandte Chemie. 30 Aug.-6 Sep. 1959".

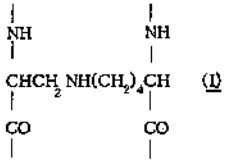
Biopterin metabolism was studied in workers and queens, using ^{14}C-biopterin. One quarter of the radioactivity was found to remain in the insect. An equal amount was determined in the pupa and the imago. The rest is eliminated as faeces prior to pupation. Biopterin scarcely metabolises into other fluorescent compounds.

210 Rembold, H. STOFFWECHSEL DES BIOPTERINS UND POLAROGRAPHISCHE CHARAKTERISIERUNG VON PTERIDINEN. (Biopterin metabolism and the polarographic characterization of pteridines.) p.485-484 of "3rd International Symposium on Pteridine Chemistry. Proceedings. Stuttgart, Federal Republic of Germany. 1962". New York, Macmillan Co. 1964. (In German)

Biopterin (I) is a characteristic component of royal jelly. Its metabolism was studied by following the development of queen larvae. Synthesis, separation, and characterization of the 6- and 7-L-erythro-1,2-dihydroxypropyl-derivatives of 2-amino-4-hydroxypteridin are described. $^{14}C_{(2)}$-I (purified chromatographically via phosphorus cellulose) was obtained as analogue. Its metabolism was investigated in rat, Drosophila melanogaster, and the bee. These insects metabolize I only slightly. In rat, the bulk of the injected I is eliminated within a few days, having undergone only slight degradation. In a growth test on Crithia fasciculata, a markedly lower activity than in I was observed in various pteridines and pyrimidines. 6-polyhydroxyalkyl-pteridines which have an OH-group in the 2-position of the side chain in the L-erythro component are an exception. The possible application of polarographic methods for determining the structure of pteridines is demonstrated by various examples.

211 Robson, A., Zaidi, Z.H. THE FORMATION OF LYSINOALANINE DURING THE TREATMENT OF SILK FIBROIN WITH ALKALI. J. Text. Inst. Trans. 58, 6 (1967) 267-269.

Mulberry leaves with ^{14}C-labelled cystine were fed to silkworms (Bombyx mori), and silk fibroin obtained contained ^{14}C-labelled cystine. The fibroin was treated with K_2CO_3, acid hydrolysed to give lysinoalanine of specific activity 2.84×10^{-3} $\mu Ci/\mu M$, and oxidized with performic acid to give cysteic acid having a specific activity of 2.98×10^{-2} $\mu Ci/\mu M$. The findings indicate that < 10% of the lysinoalanine (lysinoalanine residue (I)) formed.



(I)

has its origin in cystine. (CA 67:1967, 51505j)

212 Rock, G.C., King, K.W. AMINO ACID REQUIREMENTS OF LARVAE OF THE RED-BANDED LEAF ROLLER DETERMINED WITH GLUCOSE-U-C^{14}. Bull. ent. Soc. Am. 13, 3 (1967) 193. Abstr. 135. "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Larvae of the insect Argyrotaenia velutinana were reared aseptically on a synthetic medium containing glucose-U-^{14}C. Specific activity measurements of the amino acis indicated that the insect was capable of synthesising certain amino acids from glucose. These results agreed with those obtained by the amino acid deletion technique. (Abstr.)

213 Rodriguez, J.G., Hampton, R.E. ESSENTIAL AMINO ACIDS DETERMINED IN THE TWO-SPOTTED SPIDER MITE, Tetranychus urticae Koch (ACARINA, TETRANYCHIDAE) WITH GLUCOSE-U-C^{14}. J. Insect Physiol. 12 (1966) 1209-1216.

Amino acids were determined by the indirect method in young adult T. urticae females. The mites were maintained on bean plants in the greenhouse, starved overnight, then fed for 24 h on a chemically defined diet containing glucose-U-^{14}C. During the starvation period the concentrations of the amino acids dropped to about 10% of those in mites taken directly off bean plants and analysed. 18 protein amino acids and three non-protein amino acids were detected. The relatively high labelling found in alanine, aspartic acid, cysteic acid, cystine, glutamic acid, glycine, proline, serine, and threonine indicated that the mite is capable of synthesising these amino acids from glucose; therefore these are classified as nutritionally non-essential. Arginine, histidine, isoleucine, leucine, lysine, methionine,

phenylalanine, tyrosine, and valine showed sufficiently low activity to be classified as essential in the diet of T. urticae. Ornithine, citrulline, and α-amino butyric acid were present but not labelled. (Auth.)

214 Rogers, J.E., Jr. STUDIES ON THE BIOGENESIS OF p-BENZOQUINONES IN THE DEFENSIVE SECRETION OF A TENEBRIONID BEETLE (Eleodes longicollis). Diss. Abstr. 28, 4 (1967) 1399-B - 1400-B.

Little attention has been given to the biogenesis of the repellent components, including the simple p-benzoquinones. Potential precursors of the three p-benzoquinones isolated from the defensive secretion of the Arizona desert beetle E. longicollis were examined using ^{14}C-labelled compounds. The compounds were administered to small groups of beetles orally or by subcutaneous injection. Several days later the quinones were collected by provoking the beetle to discharge its defensive secretion from abdominal glands. Derivatives of the quinones, obtained by treatment of the crude secretion with 2,4-dinitrophenylhydrazine, were separated and purified by paper chromatography. The activity of the quinone monohydrazone derivatives was determined on a gas flow counter and corrected by comparison with a calibrated standard source. The results of these incorporation studies indicate that two separate pathways exist to the quinones. The most efficient precursors of p-benzoquinone (I) were the aromatic amino acids phenylalanine and tyrosine (uniformly labelled or specifically ring labelled). Shikimic acid was also incorporated into I, but no significant incorporation of simple aliphatic compounds was observed. Methyl-p-benzoquinone (II) and ethyl-p-benzoquinone (III) were most efficiently formed from acetate and malonate. Propionate was incorporated into III preferentially. D-Glucose and pyruvate were less efficient precursors of the alkylated quinones. These results suggest that p-benzoquinone is synthesised from the aromatic ring of phenylalanine and tyrosine, perhaps by a route analogous to that reported for ubiquinone biogenesis in the rat. The alkylated quinones (II and III) would appear to arise via the acetate pathway. The methyl group of II is probably formed from acetate, while propionate is the probable source of the ethyl group of III. This apparent biogenesis of an aromatic ring from smaller fragments was observed in entire, intact beetles. Thus, any symbiotic organisms normally present in the beetle could participate in these postulated biogenetic schemes. (From DA)

215 Sekeris, C.E. SCLEROTIZATION IN THE BLOWFLY IMAGO. Science, N.Y. 144 (1964) 419-420.

N-acetyldopamine has been identified as a dihydroxyphenylalanine metabolite in the blow fly imago during eclosion. The activity of the dihydroxyphenylalanine decarboxylase, the main enzyme responsible for its formation, which is minimal during the pupal stage, increases 1 d before eclosion. In mature larvae N-acetyldopamine-glucoside accumulates. Its concentration was determined by labelling it with 2-^{14}C-dopamine. It remained constant during pupal life until 1 d before eclosion. Metabolism of radioactive tyrosine and DOPA during eclosion followed the same pathway as in the prepupa. The similarity of dihydroxyphenylalanine metabolism in Calliphora during eclosion and during puparium formation justifies the assumption that N-acetyldopamine can be regarded as the sclerotizing agent of the imaginal cuticle. It is concluded that the formation of this substance is under the control of ecdysone.

216 Sekeris, C.E., Herrlich, P. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. XVII. DER TYROSINSTOFFWECHSEL VON Tenebrio molitor UND Drosophila melanogaster. (The tyrosine metabolism of insects. XVII The tyrosine metabolism of Tenebrio molitor and Drosophila melanogaster.) Hoppe-Seyler's Z. physiol. Che 344, 3/4 (1966) 267-275. (In German, with German and English summary)

In Tenebrio and Drosophila, as in Calliphora, there are two main pathways of tyrosine metabolism: firstly the hydroxylation to Dopa and the synthesis of N-acetyl-dopamine and secondly the degradation to phenol carboxylic acids. The analogy with sclerotising metabolism in Calliphora and the appearance of N-acetyl-dopamine at the time of sclerotisation suggest a mechanism similar to that found in the cuticle of Calliphora. Max. activities of Dopa decarboxylase in Tenebrio are also found before pupation and at the beginning of the imaginal stage. The curve of transaminase activity follows the opposite course. In Drosophila, the decarboxylase activity can be shown in vitro too. These findings are discussed in relation to results with other insects. – (U-^{14}C) tyrosine, ß-(3,4-dihydroxyphenyl)-(α-^{14}C)-alanine (=Dopa), and ß-(3,4-dihydroxyphenyl)-(α-^{14}C) ethylamine (=dopamine) were the labelled compounds used and injected, in aqueous solution, either laterally into the abdomen or subcutaneously into the larvae.

217 Sekeris, C.E. THE EFFECT OF ECDYSONE ON RNA AND PROTEIN METABOLISM IN INSECTS. p.388-394 of "Regular Nucleic Acid Protein Biosynthesis. Proceeding of an International Symposium. Lunteren, The Netherlands, 1966". Published 1967.

Enzyme induction by ecdysone (I), the effects of I on RNA metabolism in the insect epidermis, and the action of I on isolated epidermis nuclei are reviewed. I initiates sclerotization by producing the sclerotizing agent N-acetyldopamine indirectly through stimulation of mRNA synthesis and by induced enzyme formation. The primary site of action of I is on the nuclei epidermal cells. (CA 68:1968, 27722c).

218 Sekeris, C.E., Karlson, P. BIOSYNTHESIS OF CATECHOL AMINES IN INSECTS. Pharmac. Rev. 18, 1 (1966) 89-94.

After injection of glycine-2-^{14}C and aminoimidazolecarboxamide-4-^{14}C into the butterfly Pieris brassicae in the chrysalid stage, the rate of incorporation into leucopterin (I), guanine, and adenine was detected. Similar activities were observed after xanthine-2-^{14}C, showing that the biogenesis of I was not independent from purine (II) biogenesis, and that II was converted to pteridine with a min. of structural changes. (CA 64:1966, 16343a)

219 Shigematsu, H., Koyasako, T. (The article is concerned with the incorporation of ^{14}C-glycine into the posterior silk gland of Bombyx mori.) Bull. seric. Exp. Stn. Japan 17 (1961) 295-.

220 Shigematsu, H. RECENT ADVANCE IN STUDIES ON THE FIBROIN SYNTHESIS BY THE POSTERIOR SILKGLAND OF THE SILKWORM. SABCO J. 1 (1964) 21-29.

The ^{32}P-RNA in the posterior silk gland of Bombyx mori was analysed by MAK column chromatography. The chromatographic patterns obtained were essentially the same as those from Philosamia fat body RNA (see 348).

221 Shigematsu, H., Takeshita, H., Onodera, S. EFFECT OF ACTINOMYCIN AND MITOMYCIN ON FIBROIN SYNTHESIS IN THE POSTERIOR SILK GLAND OF Bombyx mori. Seikagaku Zasshi(J. Biochem., Tokyo) 58, 6 (1965) 604-606. (In English)

The posterior silk glands of B. mori larvae were removed after a single injection of actinomycin or mitomycin in various concentrations, and the incorporation of glycine-^{14}C into duct fibroin was measured. Inhibition of fibroin synthesis was observed between 3 h and 2 d after actinomycin, while mitomycin was apparently not an active inhibitor. The DNA-directed synthesis of a specific RNA appears to be an obligatory 1st step in fibroin synthesis. (CA 64: 1966, 11602d)

222 Shigematsu, H., Takeshita, H., Onodera, S. INCORPORATION OF GLYCINE-^{14}C INTO FIBROIN IN SUBCELLULAR FRACTIONS OF THE POSTERIOR SILKGLANDS OF THE SILKWORM, Bombyx mori L. Seikagaku Zasshi (J. Biochem., Tokyo) 60, 2 (1966) 140-146.

Posterior silkglands of the silkworm were collected from larvae on the 4th to 6th day of the 5th-instar and after incubation in vitro with glycine-^{14}C, incorporation of radioactivity into fibroin in subcellular fractions was studied. The greatest and most rapid incorporation was observed in the supernatant (105S) after centrifugation at 105 000 g for 60 min. After deoxycholate (DOC) treatment, the soluble part (M-S) of the fraction M (microsome) (precipitate after centrifugation at 105 000 g for 60 min) showed an incorporation curve similar to that of 105 S, but the incorporation to the DOC-insoluble (M-P) of M was less and similar to that of the DOC-soluble part (LM-S) of fraction (LM-S) (large microsomes) of fraction LM (precipitate after centrifugation at 20 000 g for 30 min). The rate of labelling of fibroin in the insoluble fraction (LM-P) after treatment of fraction LM with DOC was, as it was also the case with fraction CD, almost linear during the reaction period. After 15 min incubation, the specific radioactivity of fibroin in fraction R (particulate) was much higher than that in fraction S, which was obtained by further centrifugation of fraction 105 S for 180 min at 105 000 g. Sucrose density-gradient sedimentation analysis of fraction R and M indicated that fraction R mainly consisted of free ribosomes, while fraction M contained large, heterogeneous particles. In fraction R, the radioactivity was found in the ribosomal peak. There was unexpectedly low labelling of fraction M. The effect of ribosomes in a free state on fibroin synthesis was discussed. (Auth. summary)

223 Simon, H., Wacker, H., Walter, J. WEITERE UNTERSUCHUNGEN ZUR BIOGENESE DES LEUKOPTERINS. (Further studies on the biogenesis of leucopterin (in Pieris brassicae).) p. 327-341 of "Pteridine Chemistry. Proceedings of the 3rd International Symposium, Stuttgart, Federal Republic of Germany, Sep. 1962". New York, Macmillan Co. 1964. (In German, with English summary)

In a continuation of our experiments to elucidate the biogenesis of leucopterin, glycine-2-^{14}C and aminoimidazolecarboxamide-4-^{14}C were injected at the initial and nearly final stages of development of the cabbage butterfly pupae. The incorporation in leucopterin, guanine, and adenine and the ratios of the specific radioactivities of these substances were determined. These ratios in the wings of the butterflies always approximate to one independent of the time of application. The amount of precursors incorporated in the purines and the leucopterin increases steadily, reaching a max. at the 6th-day of development. After application of xanthine-2-^{14}C, guanine, adenine and leucopterin show very similar specific activities. From these results we conclude that the biogenesis of leucopterin is not independent from that of purine biogenesis and that the conversion purine → pteridine goes via a minimum of structural changes. 2-Amino-4-hydroxypteridine-2-^{14}C is incorporated into isoxanthopterin, but guanine and adenine also show a significant radioactivity. 2,4,5-Triamino-6-hydroxypyrimidine and 2-amino-4-hydroxypteridine-6-aldehyde are incorporated but not very efficiently. On the other hand, 2,4-diamino-5-formylamino-6-hydroxypyrimidine and 2-amino-4-hydroxy-6-(1',2',3',4-tetrahydroxybutyl) pteridine-2-^{14}C are not used by the organism. After the application of ribose-1-^{14}C to the 4, 5, 6, 7, 8 and 9-day-old pupae, the ratio of ^{14}C incorporated into C-6 and C-7 of the leucopterin goes from 42:58 to 14:86. In the butterflies, relatively large amounts of 2,8-dihydroxyadenine are found. All these results obtained fit into the general biogenesis scheme which was previously proposed by this laboratory. (Auth.)

224 Simon, H. THE BIOGENESIS OF LEUKOPTERIN AND ITS RELATION TO PURINE METABOLISM. Beitr. biochem. Physiol. Naturstoffen, Festschr. (1965) 467-475. (In German)

The pterins, as a group, are widely distributed in plants and animals and have a variety of metabolic functions and have parallels with purine metabolism. Leukopterin was isolated from Pieris brassicae (white cabbage butterfly) grown in the laboratory and was studied to determine where ^{14}C was found when the ^{14}C was given as specifically labelled compounds of purine, pyrimidines, HCO_2H, glycine, acetate, and ribose to the caterpillars and pupae. It was concluded that purine and pteridine formation must follow the same pathways in this species. (CA 65: 1966, 5942b).

225 Skinner, D.M. PROTEIN SYNTHESIS IN THE Cecropia SILKMOTH. Anat. Rec. 138 (1960) 383. Abstr. See also II/289.

The in vivo incorporation of valine-1-^{14}C into the proteins of various tissues of the Cecropia silkmoth during its life cycle and under various physiological conditions was investigated. Tissues excised from diapausing pupae 24 h after injection of labelled valine contained small amounts of the label. The specific activities (cpm) of the tissues were as follows: blood, 2; fat body, 100; epidermis, 340; midgut, 500. With the onset of adult development incorporation increased two-, 5-, 8- and 200-fold in midgut, fat body, epidermis and blood respectively. 2 d before adult emergence, all tissues were highly labelled except the fat body, which is being resorbed during that period. The specific activity of egg proteins of the old adult (8 d after emergence) was the highest obtained during these studies. In view of Harvey and Shappirio's work on injury metabolism in Cecropia and since the amino acid was injected into the silkmoths, the incorporation of valine into injured brainless diapausing pupae was also investigated. Injury raised incorporation into all tissues to the level of developing adults. An equal increase was also caused by injection of the moulting hormone ecdysone. Indeed, the hormonally treated animals showed the first signs of adult development, retraction of the epidermis. The in vivo synthesis of a single protein was also studied. Reduced cytochrome c was extracted from thoracic muscles. Its absorbency was measured at 550 m in the reduced and oxidized states. Although muscle formation begins on the 11th day after the initiation of adult development, with these methods, cytochrome c was first detected on the 17th day. It increased in amount during the next 5 d and levelled off in the adult. (Abstr. of paper read at meeting)

226 Stidham, J.D. THE FREE AMINO ACID COMPOSITION AND CERTAIN ASPECTS OF THE METABOLIC FATE OF CARBON-14 LABELLED ALPHA ALANINE AND ASPARTIC ACID IN THE AGING FEMALE MOSQUITO, Aedes aegypti (L.). Diss. Abstr. 27 (1967) 3348-B.

The free amino acids of the adult female were investigated at seven different ages in mosquitoes maintained on two different dietary regimens (sucrose, and sucrose and blood). In addition, certain

aspects of the metabolic fate of ^{14}C-labelled α-alanine and aspartic acid were studied (0.1 mCi per 1.0 ml of 0.01 N HCl). Three tissue fractions (amino acid extract, lipid fraction, and protein fractions) were analysed for radioactivity. Sixteen free amino acids were found to be consistently present in mosquitoes from the two dietary regimens: these sixteen amino acids included α-alanine, aspartic acid, glutamic acid, glycine, serine, theonine, proline, valine, methionine, isoleucine, leucine, tyrosine, phenylalanine, lysine, histidine, and arginine. Four other amino acids found but in rather low concentrations included β-alanine, taurine, cysteic acid and methionine sulfoxide. Statistical procedures applied to the data on free amino acids indicated that diet alone had less effect on individual amino acids than it did when time (age) was considered, or diet was primarily significant when time was included. Throughout the 45 d experimental period the concentrations of free amino acids in those mosquitoes given sucrose and blood were consistently higher than the concentrations in those mosquitoes given only sucrose as adults. The amino acid found to be present in the highest concentration in both sucrose fed, and sucrose and blood fed mosquitoes over the 45 d period was α-alanine, comprising from 34-52% of the total amino acid concentration. The total amino acid concentration in both sucrose fed, and sucrose and blood fed mosquitoes was found to be highest at 30 d. Mosquitoes fed sucrose and blood were found to be slightly heavier per individual mosquito than those mosquitoes maintained on sucrose alone but mosquitoes from both groups reached their heaviest weight at 16 d. Analyses of tissue fractions from mosquitoes fed ^{14}C-labelled α-alanine and aspartic acid revealed radioactivity in the amino acid extract, lipid fraction, and protein fraction. Mosquitoes fed ^{14}C-labelled α-alanine and aspartic acid were found to expire ^{14}C-CO_2 at a rather high rate shortly after uptake of the labelled compound followed soon after by a sharp decline to a low but steady rate of release. Analysis of excreta from mosquitoes fed ^{14}C-labelled alanine and aspartic acid revealed a very low activity indicating very little loss of ^{14}C by this route. The significance of free amino acids and the high percentage of alanine as well as the radioactivity of the three tissue fractions are discussed.

227 Sugiura, K., Goto, M. BIOSYNTHESIS OF PTERIDINES IN Drosophila melanogaster. Biochem. biophys. Res. Commun. 28, 5 (1967) 687-691.

The biosynthesis of pteridines was studied in D. melanogaster. The 2-amino-4-hydroxy-6-(D-erythro-1',2',3'-trihydroxypropyl)pteridine was a biopterin precursor. 2-Amino-4-hydroxypteridine (reduced) was also incorporated into biopterin. A possible metabolic pathway of pteridines was discussed. (CA 67: 1967, 98039a)

228 Telfer, W.H. THE MECHANISM AND CONTROL OF YOLK FORMATION. A. Rev. Ent. 10 (1965) 161-184.

Review article divided into sections dealing with extraovarian contributions to vitellogenesis (evidence for the uptake of blood proteins by the oocytes, protein yolk spheres as depositories of blood protein, the route of entry, formation of yolk spheres from blood proteins), ovarian contributions to yolk formation (the role of the follicle cells, of nurse cells and trophic tissues, and of the oocyte), and the control of yolk formation. Numerous studies are cited in which radioisotopes had been used (p.164-6, 169, 171-4).

229 Thomas, K.K., Nation, J.L. CONTROL OF A SEX-LIMITED HEMOLYMPH PROTEIN BY CORPORA ALLATA DURING OVARIAN DEVELOPMENT IN Periplaneta americana. Biol. Bull. 130, 2 (1966) 254-264.

The relation between corpora allata and protein synthesis during ovarian development in P. americana was studied. In all female roaches, allatectomized within 48 h after imaginal moult, the ovary remained small, and the oocytes neither grew nor deposited yolk. The haemolymph protein concentration of allatectomized roaches was low (1.09 g/100 ml) 35 d after operation, compared with the levels in the sham-operated controls (1.71 g/100 ml). Electrophoretic study of the haemolymph proteins revealed a gradual decrease and final disappearance of one of the five fractions in the experimental insects. In males, the concentration of this fraction was low compared with the females, suggesting that the formation of this group of proteins is sex-linked. Allatectomized insects showed a lower rate of incorporation of ^{3}H-labelled amino acids into haemolymph proteins (1400 cpm/mg protein) compared with the controls (2100 cpm/mg protein). In ovariectomized roaches, the total haemolymph protein concentration increased (2.59 g/100ml) 14 d after operation compared with the controls (1.82 g/100 ml). The concentration of the sex-linked fraction increased after ovariectomy. (CA 65: 1966, 4320h)

230 Threadgold, J., Sheldon, H. ON THE FINE STRUCTURE OF A NEW CYTOPLASMIC COMPONENT IN A SECRETING CELL. J. Cell Biol. 23, 2 (1964) 96A-97A. Abstr. 199, at "4th Annual Meeting of the American Society for Cell Biology. Cleveland, Ohio, USA, 11-13 Nov. 1964".

Electron microscope observations on the aciniform and ampullacral silk glands of the spider (Tegeneria derhamii) fixed in OsO_4 or glutaraldehyde and OsO_4 show that cells of this tissue, like cells of the exocrine pancreas, plasma cells, and osteoblasts, have well defined arrays of granular reticulum, a large Golgi complex, and mitochondria. The nucleus, nucleolus, and nuclear envelope are not remarkable. The silk, which has a stippled or reticulate appearance in the lumen of the glands, can be recognized in large vacuoles of the cytoplasm of these cells. In addition to these structures there are aggregates of particles (which look identical with the RNP particles) in the cell sap. These aggregates differ from the usual "rosettes" in that usually they are partly or completely surrounded by a membrane. Often the particles are very regularly arranged along the inner aspect of the membrane, in contrast to the arrangement of RNP particles of the granular reticulum, which lie along the outer surface of the cisternal membrane. The centre of this membrane-bounded new cytoplasmic component usually contains material with an appearance which resembles the silk, but in some instances the contents have an intense osmiophilia. Though a sequence of forms starting with the aggregation of several small particles and progressing through a membrane-enclosed particle-studded body to a large secretory droplet can be constructed from electron photomicrographs, the identity of the contents and the significance of the particles on the inner surface of the membrane is not clear. In order to identify the nature of these particles, alanine-^{3}H was injected into the coelomic cavity of spiders. Autoradiographs for light microscopy show labelling of the cytoplasm and silk. One interpretation of these new cytoplasmic structures is that they represent polyribosome-messenger RNA complex in situ in a cell which is secreting a material that includes a large proportion of protein, silk fibroin. (Abstr.)

231 Travis, J., McElroy, W.D. ISOLATION AND SEQUENCE OF AN ESSENTIAL SULFHYDRYL PEPTIDE AT THE ACTIVE SITE OF FIREFLY LUCIFERASE. Biochemistry 5, 7 (1966) 2170-2176.

The reaction of the competitive inhibitor dehydroluciferin with ATP in the presence of firefly luciferase has been reported to result in the masking of two of the six sulphhydryl groups of the enzyme. Because the titration of all of the sulphhydryl groups in luciferase results in total inhibition, it was of interest to determine the amino acid sequence in the vicinity of the protected sulphhydryl groups. Labelling of the essential sulphhydryl groups with N-ethylmaleimide-1-^{14}C followed by tryptic digestion resulted in the isolation of a single radioactive decapeptide whose sequence was determined. In view of these results molecular weight studies of native and denatured luciferase together with amino terminal analyses and tryptic peptide patterns of the enzyme were undertaken. The results indicate that firefly luciferase is composed of two like monomeric units of molecular weight 50 000. (CA)

232 Tsiapalis, C.M., Hayashi, Y., Chefurka, W. POLYRIBOSOMES FROM HOUSEFLIES. Nature, Lond. 214 (1967) 358-361.

Investigations of the properties of ribosomes and polyribosomes isolated from adult house fly, Musca domestica, throw new light on the part played by these structures in protein biosynthesis and suggest that nascent protein may be an important constituent that holds a polyribosome together. ^{14}C-leucine was used in the study.

233 Watanabe, H. PROTEIN SYNTHESIS IN THE TISSUES OF THE SILKWORM, Bombyx mori, INFECTED WITH NUCLEAR-POLYHEDROSIS VIRUS. J. Invertebrate Path. 9, 3 (1967) 428-429.

^{3}H-tyrosine was used as a protein precursor to analyse protein synthesis in B. mori infected with nuclear polyhedrosis. The virus was administered perorally to 4th-instar larvae. On the 5th day after inoculation the larva was given a subcutaneous injection of ^{3}H-tyrosine (specific activity 185 mCi/mM, 20 μCi/g body weight), with subsequent examination of various tissues. Protein synthesis was not found to be appreciably enhanced in diseased cells, up to a point just prior to polyhedra formation. Subsequently, active protein synthesis was very pronounced around the newly developed polyhedra and continued with polyhedral growth.

234 Watt, W.B. PTERIDINE BIOSYNTHESIS IN THE BUTTERFLY Colias eurytheme. J. biol. Chem. 242, 4 (1967) 565-572.

Quantitative data are presented on the distribution of pteridines, primary xanthopterin, leucopterin, erythropterine, and sepiapterin, in adults and developing pupae on the butterfly C. eurytheme. The

pteridine biosynthetic pathway in the developing wings of Colias was studied by the use of radioactive precursors injected into whole pupae and incubated in Ringer's solution with excised, developing wings. By comparison of the isotope incorporation by pupae and isolated wings of adenosine- and guanosine-U-^{14}C (I) and guanosine-8-^{14}C, it was concluded that Colias forms the pteridine ring from guanosine (or a phosphorylated derivative) with loss of the C-8 of guanosine. Pteridine interconversions were examined by studying the kinetics of isotope incorporation by the pteridines from I immediately after its injection into whole pupae, and by studying the incorporation patterns obtained upon incubation of isolated wings with xanthopterin-^{14}C, leucopterin-^{14}C, and erythropterin-^{14}C. The pteridine pathway is bipartite, one branch leading to position 6 side chain-bearing pteridines, the other leading to pteridines not alkylated at position 6. Within the latter branch, xanthopterin serves as precursor of leucopterin and erythropterin. The origins of the position 6 side chain of sepiapterin and the position 7 side chain of erythropterin were studied by incubation of isolated wings with radioactive pyruvate, malate, lactate, serine, threonine, and β-hydroxybutyrate. There was no incorporation into the sepiapterin side chain from any of these, but there was marked incorporation into the erythropterin side chain from pyruvate, malate, and lactate. In addition, sepiapterin made by Colias from I was oxidized to 2-amino-4-hydroxypteridine-6-carboxylic acid, and the specific radioactivities of the parent compound and oxidation product were compared. The observed loss of specific activity agrees quantitative with that expected if the sepiapterin side chain arises by modification of substitution on the initial pteridine position 6 side chain derived from guanosine ribose. The predictions of the alternative hypothesis of cleavage and replacement of the initial side chain are not compatible with the values observed. (CA 66: 1967, 53257h).

235 Wyss-Huber, M., Lüscher, M. ÜBER DIE HORMONALE BEEINFLUSSBARKEIT DER PROTEINSYNTHESE IN VITRO IM FETTKÖRPER VON Leucophaea maderae (INSECTA). (The effect of hormones on protein synthesis in vitro in the fat body of Leucophaea maderae (Insecta)). Revue suisse Zool. 73,3(1965)517-521. (In German)

Adult female Leucophaea fat body was incubated in a Warburg apparatus in the presence of ^{14}C-alanine with and without corpora cardiaca. Corpora cardiaca taken from animals in the stage of oocyte maturation stimulated oxygen consumption and synthesis of proteins in fat body of insects taken during the same phase of the sexual cycle. Incubation of fat body of pregnant females with corpora cardiaca of oocyte maturation-animals resulted in increased oxygen consumption, but had no effect on protein synthesis. The fat body responds phase-specifically to the hormone of the corpora cardiaca, which is probably stored neurosecretory material. (Auth. summary).

See also:

40 Some biochemical aspects of insect metamorphosis. (Gilbert, L.I. et al., 1961)
43 Metabolic control mechanisms in insects. (Harvey, W.R. et al., 1966)
92 Glycogen accumulation during oogenesis and its premature release by blocking of the RNA supply. (Study on Musca domestica L.) (Engels, W. et al., 1967).
95 Trehalases from the cockroach, Blaberus discoidalis: activation, solubilization and properties. (Gilby, A.R. et al., 1967)
98 Action of ecdysone on the conversion of ^{14}C-glucose in dauer pupa of the silkworm, Bombyx mori. (Kobayashi, M. et al., 1967)
99 Action of insect hormones on the fat of ^{14}C-glucose in the diapausing, brainless pupa of Samia cynthia pryeri (Lepidoptera: Saturniidae). (Kobayashi, M. et al., 1967)
104 Effect of DDT on incorporation of ^{14}C-labelled glucose into protein and soluble intermediates of nymphal Triatoma infestans. (Villar, E. del et al., 1967)
243 Control of synthesis of RNA and protein in diapausing and injured cecropia pupae. (Berry, S.J. et al., 1964)
244 Effects of hormones and injury on RNA synthesis in saturniid moths. (Berry, S.J. et al., 1967)
253 The induction by ecdysone of puff modifications in the salivary gland chromosomes of Chironomus tentans. (Clever, U. et al., 1960).
256 Induction and repression of a puff in Chironomus tentans. (Clever, U., 1966)
257 Gene activity patterns and cellular differentiation. (Clever, U., 1966)
268 Radioisotope incorporation and nucleic acid synthesis in dipteran embryos. (Eudy, W.W. et al., 1967)
280 The role of the nucleus in RNA and protein metabolism of the Chrysopa perla oocytes. (Gruzova, M.N., 1966)

285 Study on the structure and function of the lampbrush Y-chromosome in Drosophila. (Henning, W. 1967)

286 Effects of substrates on gene-controlled enzyme activities in cultured embryonic cells of Drosophila. (Horikawa, M. et al., 1967)

288 Effects of actinomycin D on nucleic acid metabolism and protein biosynthesis during metamorphosis of Tenebrio molitor. (Han, J. et al., 1966)

298 Regulation of gene action in insect development. (Kroeger, H. et al., 1966)

309 RNA and protein synthesis in puffs of isolated salivary gland chromosomes of Chironomus. (Lezzi, M., 1967)

311 Insect embryogenesis: macromolecular syntheses during early development. (Lockshin, R.A., 1966)

312 Variations in metabolic activity during the larval development of Rhynchosciara. (Mattingly, E. et al., 1966)

313 Variations in metabolic activity during the larval development of Rhynchosciara. (Mattingly, E.M., 1966)

321 Juvenile hormone and RNA synthesis in pupal tissues of saturniid moths. (Oberlander, H. et al., 1966)

332 Incorporation of uridine and leucine in vitro by Cecropia silkmoth wing epidermis during diapause and development. (Reddy, S.R.R., 1967)

334 Aspects of structure of polytene chromosome puffs of Drosophila busckii derived from experiments with antibiotics. (Ritossa, F.M. et al., 1963)

346 Nucleic acid and protein synthesis in saturniid pupae. (Spencer, J.B., 1967)

349 RNA, protein, and uric acid content of body tissues of Periplaneta americana (L.) as influenced by corpora allata during ovarian development. (Thomas, K.K. et al., 1966)

356 "Conference on Insect Endocrines, Brno, Czechoslovakia, 22-26 Aug., 1966". (Wyatt, G.R., 1966)

359 Etudes de la formation de l'acide ribonucléique et des protéines chez les insectes. (Zalokar, M., 1965)

363 Isolation of diglyceride-bound lipoprotein from insect hemolymph. (Chino, H. et al., 1967)

416 Study on the function of nurse cells in meroistic insect ovaries, with special reference to oogenesis in adephagous Coleoptera. (Bier, K., 1965)

417 Oogenesis, the growth of giant cells. (Bier, K., 1967)

418 Structure and function of oocyte chromosomes and nucleoli and extra-DNA during the oogenesis of panoistic and meroistic insects. (Bier, K. et al., 1967)

419 The deposition of endocuticle in an insect, Calpodes ethlius Stoll (Lepidoptera, Hesperiidae). (Condoulis, W.V. et al., 1966)

446 Hormonal control of reproduction. - I. Initiation of oocyte development in the isolated abdomen of Leucophaea maderae. (Chambers, D.L. et al., 1967)

453 Oogenesis in Hyalophora cecropia. (King, R.C. et al., 1965)

458 Metabolism of proline in insect flight muscle and its significance in stimulating the oxidation of pyruvate. (Sacktor, B. et al., 1967)

462 Biochemical changes in the larvae of the variegated cutworm, Peridroma saucia, after infection with a nuclear polyhedrosis virus. (Van der Geest, L.P.S., 1967)

568 Use of radioisotopes for studies on the ecology of tick vectors of disease. Progress Report, April 1, 1966 - January 1, 1967. (Sonenshine, D.E., 1966)

597 Cerebral amino acid transport in vitro: effect of hypoxia induced by cyanide in vivo. (Levi, G. et al., 1967)

1.2.5. Nucleic Acids. Nucleotides.

236 Akai, H. RNA SYNTHESIS OF THE SILK GLAND IN THE SILKWORM, Bombyx mori. J. Electron Microsc., Chiba Cy 14, 4 (1965) 336. (In English)

By light microscopic and electron microscopic autoradiography, the synthesis and intracellular shifts of RNA were studied in the silk gland of 5-d-old larvae. Each animal was injected with uridine-^{3}H and 4 γ of thymidine. From 5 min to 24 h after injection a part of the gland was removed for microscopic examination. The result indicated that the bulk of RNA in the posterior silk gland was

synthesised in the nucleus in about 30 min after the injection of precursor and transported on rough endoplasmic reticulum in the cytoplasm in 24 h. (CA 65: 1966, 14161f)

237 Arnold, D.G. AN AUTORADIOGRAPHIC STUDY OF RNA SYNTHESIS IN ISOLATED SALIVARY GLANDS OF Drosophila hydei. Diss. Abstr. 28, 3 (1967) 1260-B – 1261-B.

The characteristics of RNA synthesis in D. hydei have been studied using autoradiographic techniques. A method for correcting grain counts for self-absorption of B-particles is discussed. The correction factor was calculated using determinations of dry mass made by interference microscopy. It was found that the uncorrected grain counts for nucleolus were too low by a factor of 12, those for nucleoplasm, by a factor of 3.6, and for the cytoplasm, by a factor of 7.4. When isolated salivary glands were exposed to uridine-^{3}H for a 15-sec interval, label was localized primarily over the nucleolus; with a 1-min exposure to isotope, RNA in the nucleoplasm also was labelled. It was concluded that some portion of the nucleolar RNA is synthesized in the nucleolus, and is not transferred from other regions of the nucleus. However, an examination of the time-course of incorporation does not exclude the possibility of a chromosomal origin of some fraction of nucleolar RNA. After extraction of RNA with N HCl after incorporation of uridine-^{3}H, a small percentage of the label was retained; this label was assumed to be incorporated in DNA, possibly by conversion of uridine-^{3}H to thymidine-^{3}H. In Feulgen-stained nuclei, this non-extractable label was earliest apparent over the nucleolus, and with longer intervals in isotope, also appeared over the chromatin. In glands which had been pre-incubated in Actinomycin D before exposure to uridine-^{3}H, it was found that the non-extractable label was present only over the chromatin; the antibiotic inhibited incorporation of label into the intranucleolar DNA. A 15-min preincubation with 10^{-7} M Actinomycin D, followed by a 3-min exposure to uridine-^{3}H, revealed an 80% inhibition of RNA synthesis in both nucleolus and nucleoplasm. With longer exposures to uridine-^{3}H, a gradual increase in the amount of isotope incorporated in both nucleolus and nucleoplasm was apparent. Glands which were incubated 15 min in isotope after Actinomycin pretreatment incorporated about 50% of the control level of label in both nucleolus and nucleoplasm. A delayed appearance of label in cytoplasmic RNA indicated a dependence of this labelling on some nuclear process which is affected by Actinomycin D. Incorporation patterns of uridine-^{3}H and cytidine-^{3}H were compared by exposing isolated salivary glands to labelled precursors, followed by transfer to a solution of unlabelled nucleosides. The data suggest that two different RNA's are present in the nucleolus. One fraction is characterized by a higher uridine incorporation, a rapid synthesis and rapid disappearance from the nucleolus. The second fraction incorporated less uridine, was synthesized more slowly, and remained associated with the nucleolus for longer periods of time. Similarities in the isotope incorporation patterns of the rapidly turning over nucleolar fraction and the RNA of nucleoplasm suggest that this might be a messenger type of RNA. (DA)

238 Barigozzi, C., Dolfini, S., Fraccaro, M., Rezzonico Raimondi, G. IN VITRO STUDY OF THE DNA REPLICATION PATTERNS OF SOMATIC CHROMOSOMES OF Drosophila melanogaster. Expl Cell Res. 43, 1 (1966) 231-234.

Embryonic cells were treated with thymidine-^{3}H and radioautographed. Exposure for 6 h to thymidine-^{3}H resulted in 90% labelling of the metaphases. After 3.5 - 4 h of exposure, 60% of the metaphases were labelled. All of the chromosomes were labelled in most species, indicating that the cells picked up the label at various stages of the 2nd half of the S period. In male cells, the Y chromosome was either late in duplicating or the last to terminate synthesis along its entire length. The IV pair of autosomes was frequently labelled together with the sex chromosomes, while the other 2 pairs had little or no label. The data suggest that the pattern of late DNA replication coincides with the gross distribution of heterochromatin. (CA 65: 1966, 18902c)

239 Barr, H.J., Plaut, W. NUCLEOLAR DNA IN Drosophila. J. Cell Biol. 31, 2 (1966) 10A. Abstracts of Papers Presented at the "6th Annual Meeting of the American Society for Cell Biology, Houston, Tex., USA. 17-19 Nov. 1966". Abstr. 15.

Elements containing DNA have been found in association with nucleoli of third instar larval salivary gland cells of various Drosophila species. This DNA is defined by its secondary fluorescence when stained with acridine orange or coriphosphine O, its sensitivity to nuclease digestion, and, in the cases tested, its capacity to incorporate ^{3}H-thymidine or to show a positive Feulgen reaction. It is seen within or on the surface of nucleoli in standard squash preparations. Although there may be variations in the appearance of this material with larval age, its morphology is to a large extent

species specific. The striking differences in morphology in different species make it highly unlikely that the material is randomly removed from the chromosomes and fused with the nucleolus during preparation. In some species, e.g. D. virilis and D. hydei, a single large chunk of DNA is found, often accompanied by smaller fibres and flecks. In D. repleta the nucleolar DNA takes the form of swirls which normally do not extend to the periphery of the nucleolus. DNA-containing fibres running between nucleoli and chromosomes can be seen in all species studied; the chromosomal regions involved include, but are not restricted to, the chromocenters. In D. melanogaster there is no obvious difference in amount of nucleolar DNA between cells known to have 1, 2, and 3 nucleolar organizing regions. Nor is there an obvious difference in this respect between males and females of D. ananassae, known to have 3 and 2 nucleolar organizing regions, respectively. (Abstr.)

240 Benz, G. NUCLEIC ACID METABOLISM OF HEALTHY AND VIRUS-INFECTED LARVAE OF Diprion hercyniae. Vjschr. naturf. Ges. Zürich 112, 1 (1967) 29-70. (In German)

The metabolism of nucleic acids in healthy and polyhedrosis-infected larvae of D. hercyniae was studied, employing autoradiographic, biochemical, and histological methods. Infection by the virus stimulates the synthesis of nuclear DNA (multiplication of chromosomes and enlargement of nuclei), possibly as a defense reaction of the cell. By this process, enzymes necessary for DNA replication and virus multiplication are produced. After a short lag period, the virus interferes with chromatin synthesis. Although the virus does not depend on the building stones derived from host DNA, the breakdown of host chromatin is induced. At the same time, virogenic stromata are formed, and the synthesis of virus DNA begins at a very high rate in these structures. Shortly after the host DNA has been completely broken down, the synthesis of viral DNA stops. (CA 68: 1968, 10715c)

241 Berendes, H.D. DIFFERENTIAL REPLICATION OF MALE AND FEMALE X-CHROMOSOMES IN Drosophila. Chromosoma 20 (1966) 32-43.

The replication patterns of larval salivary gland chromosomes of D. hydei and D. melanogaster were studied by autoradiography with ^{3}H-thymidine injected in mid third-instar larvae. Larvae were injected with 1 µl Ringer's solution containing 1 mCi/ml ^{3}H-thymidine (specific activity 14.5 Ci/mM); the effective thymidine concentration in D. hydei larvae was 0.4 µCi/mg body wt. The male X-chromosome showed a different replication behaviour in comparison to that of the female X-chromosome and autosomes. It is concluded that the male X-chromosome finishes its replication earlier than the female X-chromosome. Moreover, the time needed for a complete replication cycle of individual identical replication units was found to be shorter in the male than in the female X-chromosome. Although the whole X-chromosomes behave differently there were no differences observed in the sequence of the discontinuous labelling patterns of the two types of X-chromosome. One autosomal replication unit was observed which showed a different replication behaviour in males and females. The possible origin of the differential behaviour of the two X-chromosomes is discussed in terms of their difference in degree of polyteny.

242 Berendes, H.D., Keyl, H.G. DISTRIBUTION OF DNA IN HETEROCHROMATIN AND EUCHROMATIN OF POLYTENE NUCLEI OF Drosophila hydei. Genetics 57, 1 (1967) 1-13.

The brain ganglion of Drosophila contains diploid as well as polytene cells. This tissue is therefore particularly suitable for a study of the replication and quantitative distribution of heterochromatin and euchromatin in early polytenic stages. Thymidine-^{3}H autoradiography revealed that the heterochromatin and the euchromatin showed an asynchronous, but in most cases overlapping, period of DNA synthesis in the diploid cells. Cytophotometric DNA measurements showed that the total values for nuclear DNA of the nuclei measured could not be arranged into a geometric series of classes originating from the diploid value. When the values for chromocentral heterochromatin and the euchromatin were separated, a good geometric distribution of the values of each of the types of chromatin was established. The polytene nuclei generally showed different classes of heterochromatin, which were sometimes but not always in accordance with the class expected on the basis of the euchromatin value. It is assumed that the process of polytenization involves an independent replication of euchromatin and heterochromatin, and that the number of replication steps completed by each of the types of chromatin can be different. (Auth. summary)

243 Berry, S.J., Krishnakumaran, A., Schneiderman, H.A. CONTROL OF SYNTHESIS OF RNA AND PROTEIN IN DIAPAUSING AND INJURED CECROPIA PUPAE. Science, N.Y. 146 (1964) 938-940.

^{3}H-uridine, 10 µCi/g wet weight, was injected at various times after injury to determine which tissues showed an increased synthesis of RNA in response to injury. Injury could be shown to stimulate RNA

synthesis in all pupal tissues, also the synthesis of several blood proteins. A precocious synthesis of a protein ("injury protein") which normally appears in the blood during adult development was also found to be stimulated by injury. This was confirmed by experiments involving the injection of ^{14}C-labelled algal protein hydrolysate (1.48 mCi/mg). Actinomycin D, injected as 2 μg/g of body weight, blocks the injury-stimulated increase in blood protein synthesis and the injury-induced synthesis of injury protein. At concentrations of 0.5 μg/g, however, it prevents the induction of injury-protein synthesis but does not prevent the increased synthesis of other blood proteins. These results suggest that low concentrations of actinomycin may inhibit the synthesis of new kinds of messenger RNA but still permit the continued synthesis of mRNA's already in production at the time the actinomycin is injected.

244 Berry, S.J., Krishnakumaran, A., Oberlander, H., Schneiderman, H.A. EFFECTS OF HORMONES AND INJURY ON RNA SYNTHESIS IN SATURNIID MOTHS. J. Insect Physiol. 13, 10 (1967) 1511-1537.

The rate of RNA synthesis during post-embryonic life was studied in related silkmoths (Saturniidae): Hyalophora cecropia, Samia cynthia walkeri, and Antheraea polyphemus, which have a pupal diapause, and S. c. ricini which normally has no diapause. Autoradiographic determinations were made of the rate of incorporation of ^{3}H-uridine in various tissues during normal development and in insects subjected to endocrinological and surgical manoeuvres. The effects of inhibitors of RNA and protein synthesis during the life cycle were also analysed. The effects of inhibitors of RNA and protein synthesis during various stages of the life cycle were also analysed. The rate of RNA synthesis in many tissues roughly paralleled the rate of respiration during various stages of the life cycle, but there were significant differences in temporal patterns of RNA synthesis not only between tissues but within a tissue. During larval moult cycles chitogenous epithelia such as epidermis, tracheae, and foregut showed temporal patterns of RNA synthesis which correlated directly with the process of moulting. In other tissues the temporal patterns of RNA synthesis did not parallel the events of the moult cycle. The rate of RNA synthesis was higher during larval life than in any other stage. After pupation RNA synthesis decreases in most tissues and is extremely low during diapause at which time only a few tissues such as haemocytes, brain, oenocytes, Malpighian tubules, and perigonadal fat body continue to synthesise RNA at significant rates. During the first half of the pupal-adult transformation, the rate of RNA synthesis increased initially, but thereafter it decreased in many tissues. Integumentary injury to diapausing pupae stimulated RNA synthesis. A systematic stimulation of RNA synthesis which roughly paralleled the increased respiration stimulated by injury was observed in all tissues except the gonads. A pupal cuticle was synthesised by the regenerating epidermis in the absence of juvenile hormone. When RNA synthesis was blocked in diapausing pupae with actinomycin D, pupae survived and continued to synthesise proteins for 24 d, suggesting that messenger RNAs survive for many days. When protein synthesis was blocked with puromycin, diapausing pupae died within 17 d. During periods of rapid RNA synthesis such as larval life, early stages of adult development and after injury, the insects were promptly killed by low doses of actinomycin. When RNA synthesis was low, such as during diapause, in late states of adult development, and during adult life, they were insensitive to large doses of actinomycin. Experiments on developing adults indicated that the mRNA for many specific developmental events was made many days prior to the event.

245 Bier, K., Ribbert, D. STRUKTUR UND GENETISCHE AKTIVITÄT DES DNA-KEIMBAHNKÖRPERS VON Dytiscus. (Structure and genetic activity of the DNA mass in evidence during germ cell development.) Naturwissenschaften 53, 4 (1966) 116. (In German)

A mass of extrachromosomal DNA appears in the ovary of Dytiscus during germ cell development until it finally reaches the nucleus of the oocyte. It consists of fine fibrils. In Dytiscidae ^{3}H-uridine was found to be incorporated into the entire region within the oocyte nucleus taken up by these fibrils. Such incorporation was not confined to the early stages but also continued in the later stages of oogenesis. The possible function of the DNA mass is discussed at this admittedly preliminary stage of the investigation.

246 Birnstiel, M.L., Jacob, J., Sirlin, J.L. ANALYSIS OF NUCLEOLAR RNA SYNTHESIS IN DIPTERAN SALIVARY GLANDS. Archs Biol., Liège 76, 1/4 (1965) 563-587.

Salivary glands of larvae of Smittia parthenogenetica removed at the 5th week were incubated with uridine (I)-2-^{14}C, I-U-^{14}C, I-5, 6-$^{3}H_2$, I-5-^{3}H, L-methionine (II)-methyl-^{14}C, and II-^{35}S. Sucrose

gradient analysis of RNA synthesised by the glands showed the newly formed RNA to be highly heterogeneous with labels in soluble RNA, ribosomal RNA, and RNA larger than 28 S. In the presence of DRB (5,6-dichloro-1 (β-D-ribofuranosyl) benzimidazole) and TRB (4,5,6-trichloro-1 (β-D-ribofuranosyl) benzimidazole) the incorporation of labelled material into the RNA of the chromosomes and cytoplasm, but not the nucleolus, was inhibited. Radioactivity in this case was mainly in low-molecular-weight RNA (4S). Label from II-methyl-^{14}C was transferred almost specifically to the nucleolar 4S RNA, the transfer of ^{14}C representing transmethylation to the RNA. The amount of methionyl-^{14}C-RNA was very small. When incubated with I-U-^{14}C the nucleolar RNA contained a significant amount of ribothymidine-^{14}C, further supporting the theory that transmethylation is to newly synthesised 4S RNA. (CA 65: 1966, 14160b)

247 Camargo, E. Plessmann, Plaut, W. THE RADIOAUTOGRAPHIC DETECTION OF DNA WITH TRITIATED ACTINOMYCIN D. J. Cell Biol. 35, 3 (1967) 713-716.

Salivary glands were derived from 3rd-instar larvae of Drosophila melanogaster and D. hydei. ^{3}H-actinomycin D was used (0.3 ml of 10μCi/ml of water). Acid and enzyme extractions preceded exposure to actinomycin D. The specificity of ^{3}H-actinomycin D binding for DNA is evident from (1) label only being detected at known DNA sites, and (2) a total absence of label following predigestion of preparation with DNase. RNase has no measurable effect on subsequent binding of actinomycin D. The amount of binding is affected by the method of fixation. Hydrolysis of salivary gland squash preparations with HCl results in complete suppression of subsequent binding. - Attempts to demonstrate in vivo binding of actinomycin D are discussed.

248 Caspari, E. W. SOMATIC MUTATIONS IN THE MOTH Ephestia. Report on Research, August 1, 1964 - September 1, 1967. NYO-2902-11, Rochester Univ., N.Y. 46p.

Progress is reported on studies on the induction of somatic mutations in the moth Ephestia by the injection of 5-bromodeoxyuridine, 5-fluorouracil, or DNA from Ephestia during various developmental stages. ^{3}H-thymidine was used in conjunction with 5-BDU.

249 Caspari, E. W. SOMATIC MUTATIONS IN THE MOTH Ephestia. NYO-2902-10, Rochester Univ., N.Y. 14 Sep. 1967, 18p.

The influence of 5-BDU on the formation of abnormal scales was studied. Labelled 5-BDU injected into last-instar larvae is taken up by the nuclei of the wing buds. 5-BDU and thymidine, injected into last-instar larvae, induce an immediate increase in the number of mitoses, followed already after 3 h by a decided drop. Labelled thymidine is not found to be incorporated into mitotic figures up to 2 h after injection, and only a small proportion of metaphases are labelled up to 24 h after injection. It is concluded that the G-2 period is very long or irregular, so that there is no relation between DNA synthesis and the time of the next mitosis.

250 Chaudhary, K. D., Lemonde, A. IN VIVO SYNTHESIS AND BREAKDOWN OF DEOXYRIBONUCLEIC ACID IN Tribolium confusum Duval. Can. J. Biochem. 44, 12 (1966) 1571-1575.

The in vivo synthesis of DNA, as shown by the rate of incorporation of ^{14}C-thymidine, has been investigated at different stages in the life cycle of T. confusum. During the larval period, a close similarity is observed between the rate of DNA synthesis and the pattern of growth. The pupal stage, which is a non-growth phase, is characterized by a cessation of DNA synthesis. During the larval growth phase, although the 3-d-old larvae have the lowest and the 13-d-old have the highest rate of DNA synthesis, the rate of DNA degradation in the older larvae is almost twice as great as that of the younger larvae. These findings are consistent with the observed total concentration of DNA of the insect at these stages. (Auth.)

251 Clarke, K. U., Gillott, C. STUDIES ON THE EFFECTS OF THE REMOVAL OF THE FRONTAL GANGLION IN Locusta migratoria L. - II. RIBONUCLEIC ACID SYNTHESIS. J. exp. Biol. 46, 1 (1967) 27-34.

A cytochemical investigation was made of the RNA content of the cells of the mid-gut, fat body and epidermis in 3rd- and 4th-instar L. migratoria L. from which the frontal ganglion had been removed, in control operated and in starved animals. In operated locusts the nucleus was smaller, the nucleoli small or absent, and the cytoplasmic RNA much less than that found in operated controls. No differences

were observed in the DNA content of the cells. No "all-or-none" effect has ever been noted following the removal of the frontal ganglion. For example, there was some synthesis of mid-gut protease, some incorporation of uridine into RNA within the nucleus, and some incorporation of ^{14}C-glycine into protein. Autoradiograph studies were made of the uptake of ^{3}H-uridine into the cells of operated and control operated locusts. In operated locusts the appearance of labelled uridine in the nucleus was delayed, the rate of uptake slower, and the total amount incorporated less (never more than 25%) than in the controls. Studies were made of the uptake of ^{14}C-uridine into the nuclei of operated and control operated locusts. Nuclei were isolated from locusts killed at known times after the isotope had been injected and their radioactivity was measured. The results confirmed those found in the radioautographic studies. The significance of these results is considered in the light of the Jacob & Monod model of the control of protein synthesis.

252 Claypool, C. J. , Bloch, D. P. SYNTHESIS OF RIBONUCLEIC ACID AND HISTONE CHANGE DURING SPERMATOGENESIS IN THE GRASSHOPPER Chortophaga viridifasciata. Nature, Lond. 215 (1967) 966-967.

The correlation between RNA synthesis and changes in staining reaction with fast green and eosin was investigated in spermatids. Nymphs were injected with 6 μCi of ^{3}H-uridine (specific activity 1.15 Ci/mM), killed 5 or 6 h after injection, and subsequently fixed and stained. A striking negative correlation between RNA synthesis and eosinophilia was observed during spermiogenesis. Decline in RNA synthesis during meiotic chromosome condensation and during the later spermatid stages was accompanied by an increase in eosinophilia and a masking of the fast green staining. The nature of the eosinophilic protein is not known, but is probably a histone because it is a basic nuclear protein which requires the removal of DNA before staining. The eosinophilic histone, probably rich in lysine, may play the part of a non-specific regulator of RNA synthesis in the nucleus as a whole.

253 Clever, U., Karlson, P. INDUKTION VON PUFF-VERÄNDERUNGEN IN DEN SPEICHELDRÜSEN-CHROMOSOMEN VON Chironomus tentans DURCH ECDYSON. (The induction by ecdysone of puff modifications in the salivary gland chromosomes of Chironomus tentans.) Expl Cell Res. 20, 3, Pt. 2 (1960) 623-626.

^{3}H-ecdysone was injected into last-instar larvae, and the chromosomes autoradiographed. The modifications observed in the chromosomes are apparently a morphological indication of gene activity in the particular regions involved.

254 Clever, U., Beermann, W. STUDIES OF NUCLEO-CYTOPLASMIC INTERRELATIONS IN GIANT CHROMOSOMES OF DIPTERA. Int. Congr. Zool. 4 (1963) 210-215.

The distribution of active sites within the genome as well as the relationship of their activity to other physiological processes within the cell has been studied in different laboratories, making use of the "puff" phenomena which occur in the giant chromosomes of Diptera and which have been accepted to represent synthetically active genes. Work in this field is reviewed, and numerous studies quoted in which autoradiographic techniques had been used.

255 Clever, U. CHROMOSOMAL CHANGES ASSOCIATED WITH DIFFERENTIATION. p. 242-253 of "Genetic Control of Differentiation", Presented at the "18th Brookhaven Symposium, Upton, N.Y., USA, 7-9 Jun. 1965". BNL-931, Brookhaven National Lab., Upton, N.Y. 275p.

Special attention is paid to puffing phenomena. Various differences in chromosomal structure and changes in differentiation are discussed, also the action of ecdysone. Autoradiographic methods are used routinely in much of this work.

256 Clever, U. INDUCTION AND REPRESSION OF A PUFF IN Chironomus tentans. Devl Biol. 14 (1966) 421-438.

Two puffs in salivary glands, I-18-C and IV-2-B, seem to be controlled by the concentration of ecdysone. Towards the end of the moulting periods, IV-2-B regresses while I-18-C is still of maximal size. Injection of ecdysone into old prepupae does not re-induce IV-2-B, whereas this locus in larvae of all other stages rapidly responds to the hormone. Haemolymph from old prepupae without IV-2-B induces puffs I-18-C and IV-2-B when injected into last-instar intermoult larvae, and thus stimulates the effect of injected ecdysone. This ability is not lost by heating the haemolymph to 80°C. Haemolymph from intermoult larvae does not have any effect, whereas haemolymph from

very young last-instar larvae and from young prepupae apparently has a slight effect on I-18-C, but no effect on IV-2-B. Treatment with cycloheximide results in the reappearance of IV-2-B in old prepupae, although it has no effect on puffing at this locus in larvae of other stages. To examine the effect of cycloheximide on protein synthesis, ^{3}H-leucine and ^{3}H-valine (~ 50 μCi/ml) were injected into larvae after various periods of treatment and incorporation was allowed for 1 or 6 h. To examine the effect on RNA synthesis, glands were explanted at various intervals and incubated in a ^{3}H-uridine-sucrose medium (10 μCi/ml) containing 10 μg/ml cycloheximide. Almost no incorporation of ^{3}H-amino acids into cytoplasm or TCA precipitating material was detected after 4 h of cycloheximide treatment, while incorporation of ^{3}H-uridine into chromosomes and nucleoli was unchanged after even 24 h. The ^{3}H-uridine incorporation pattern in cycloheximide-treated glands and in control glands were compared. Puffing is prevented by actinomycin D. It is concluded that the titer of ecdysone is high at the end of the pupal moult. This implies an antagonistically acting factor at this stage which represses IV-2-B. The apparent relationship of this factor to protein synthesis is considered.

257 Clever, U. GENE ACTIVITY PATTERNS AND CELLULAR DIFFERENTIATION. Am. Zool. 6 (1966) 33-41.

Puffing in giant chromosomes of Diptera is considered to reflect the pattern of active gene loci in these chromosomes. In any one tissue only a relatively small portion of the total bands (about 10 to 20%) have been observed to form a puff at some time or another in larval development. These patterns of "potentially active" loci are tissue specific, though greatly overlapping. The actual rate of activity at these loci is controlled independently of each other and independently in each tissue by factors of the extranuclear metabolism. Puffing at some loci seems to be related to specific cellular functions, such as secretion of the salivary glands. The activity of others may be related to more basic metabolic processes. In relation to larval development, puffing patterns may change with changing cell functions or with developmental processes in the cells themselves. In salivary glands of Chironomus activity of DNase and of acid phosphatase seems to change in relation to cell breakdown at the end of the pupal moult. Changes of acid phosphatase activity begin early in the last larval instar, but the enzyme is bound to lysosomes until metamorphosis. This suggests that the genes specifically active during metamorphosis have to interact with a long-term control-system of development. The induction of metamorphosis is a sequential process, gene activations being among the first steps in this sequence. The activation of these genes by ecdysone is independent of protein synthesis. It is only the reaction of these genes that leads to the subsequent events in the cell, including the subsequent puff activations. This is shown by the fact that they depend on early RNA synthesis as well as on protein synthesis.* These results on puffing are discussed with regard to the general problem of the relationships between patterns of gene activity and differentiation. (Auth.)

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* Numerous supporting studies in which autoradiographic techniques had been used are cited.

258 Daillie, J. THYMIDINE METABOLISM IN THE SILK GLAND OF THE SILKWORM. I. THE MAIN PATHWAYS OF THE PRECURSOR IN THE IN VITRO-INCUBATED GLAND. Annls Biol. anim. Biochim. Biophys. 7, 2 (1967) 115-129. (In French)

Thymidine metabolism of the silk gland secretory tube was examined during in vitro incubation of glands taken on the 4th day of the 5th stage. The cell walls showed a high permeability to thymidine, and the nucleoside was converted to nucleotide in the glandular cells; catabolic reactions were negligible. The total amount of nucleotide formed increased to a max. within a 30 min incubation, and this max. level was maintained for at least 30 min. Some synthesised nucleotides were released into the incubation medium. Thymidine mono-, di-, and tri-phosphates were formed, the latter during the 1st 5 min of incubation. The equilibrium between the various enzymic reactions changed during the incubation. Although the total quantity of nucleotides increased, the relative proportions of thymidine triphosphate and monophosphate, but not of thymidine diphosphate, varied. The phosphorylation reaction appeared to be blocked at the initial stages after the 1st 5 or 10 min of incubation, although the production of thymidine triphosphate increased during the 2nd 15 min of incubation. Thymidine was incorporated into DNA at a constant rate, and the labelling of DNA appeared to be insensitive either to variations in the amount of thymidine triphosphate or to the increase in the amount of labelled nucleotides. (CA 68: 1968, 1149w)

259 Daillie, J. THYMIDINE METABOLISM IN THE SILK GLAND OF Bombyx mori. II. UTILIZATION OF RADIOACTIVE NUCLEOTIDES IN DNA SYNTHESIS BY THE IN VITRO-INCUBATED GLAND ON THE 4TH DAY OF THE 5TH INSTAR. Annls Biol. anim. Biochim. Biophys. 7, 3 (1967) 227-243.

In in vitro incubations, radioactive thymidine in the medium was exchanged with part of the endogenous thymidine in the silk glands obtained from silkworms in the 4th day of the 5th instar. However, not all of the precursor was directly available for DNA synthesis. A reserve compartment and an active compartment within the cell are postulated. (CA 68: 1968, 76076d)

260 Daillie, J. METABOLISME DE LA THYMIDINE DANS LA GLANDE SERICIGENE DU VER A SOIE III. INCORPORATION DE LA THYMIDINE RADIOACTIVE DANS LA GLANDE SERICIGENE PRELEVEE AU 6^{e} JOUR DU 5^{e} AGE ET INCUBEE "IN VITRO". Annls Biol. anim. Biochim. Biophys. 7, 4 (1967) 347-354. (With English summary)

^{3}H-methyl thymidine was used. Though the DNA synthesis in the silk gland on day 6 of the 5th stage is slowed down, thymidine easily penetrates into the in-vitro incubated gland. The activity of the phosphorylating kinases is lower than in younger glands. However, the rate of production of the nucleotides is higher than their rates of utilization by DNA, which incorporates the precursor at a very low rate. On increasing the thymidine concentration of the medium, the incorporation of the precursor into DNA soon reaches a max. (0.05% nucleic acid synthesis/h). The amount of endogenous thymidine precursors available could not be accurately estimated; it is ~0.01% of the thymidilic contents of the gland DNA, and does not seem to be capable of ensuring more than a 15 min synthesis. The possible parts played by thymidine kinases and endogenous precursors in the regulation of DNA synthesis are discussed.

261 Daillie, J. METABOLISME DE LA THYMIDINE DANS LA GLANDE SERICIGENE DU VER A SOIE. IV. ETUDES SUR LA GLANDE "IN SITU". Annls Biol. anim. Biochim. Biophys. 7, 4 (1967) 355-372. (With English summary)

The transport towards the silk gland of the nucleoside injected in the haemocoel is very fast. Experiments were carried out on days 3 and 4 of the 5th instar. At both ages, the main part of the thymidine disappears from the haemolymph within 10-15 min, due to immediate metabolism of the nucleoside. On day 3, 15 min after injection of labelled thymidine, radioactivity in the gland is due to nucleotides or degraded compounds. The labelled nucleotides (thymidine-2-^{14}C and ^{3}H-methyl-thymidine) are soon incorporated in the pool of endogenous precursors. The rate of disappearance of labelled nucleotides may therefore by roughly equalled to the rate of renewal of the endogenous pool, i.e. 0.6 times/h on day 3. Under these conditions, the precursor is very quickly incorporated in DNA, from the start of the experiment. The rate of labelling then slows down; peak DNA radioactivity is reached within 2-8 h, on days 3 and 4. The decrease in specific radioactivity allows DNA synthesis in the gland to be estimated. On day 6, a slowing up of the various processes was observed. - Findings are compared with in vitro results.

262 Danieli, G.A., Rodino, E. LARVAL MOLTING CYCLE AND DNA SYNTHESIS IN Drosophila hydei SALIVARY GLANDS. Nature, lond. 213 (1967) 424-425.

Larvae from the late 2nd to the late 3rd instar were given ^{3}H-thymidine in their diet during 1 of 11 8-h periods comprising the developmental span studied. Autoradiography of the salivary glands showed an initial intensive synthesis to 4.5 times the original DNA after which the labelled nuclei decreased rapidly to ~20% of the amount observed with the moult. At 132 h, a new period of synthesis occurred increasing to the puparium. The DNA content per gland during a restricted period in the 3rd instar corresponded to at least two doublings. The data relate the cycle with physiological events in moulting but not with ecdysone. (CA 66: 1967, 83513f)

263 Desai, L., Ficq, A., Gérard, C., Lacroix, N., Tencer, R. Laboratoire de Morphogenèse expérimentale et de la Physiologie cellulaire. 6. Cellules différenciées - Divers. 6.2. Chromosomes géants des larves de Diptères. p.67-68 of "Applications radiobiologiques de la physiologie cellulaire. Rapport Final 1961-1966". EUR 3607 f, European Atomic Energy Community, Brussels (Belgium). 1967, 137p.

A group consisting of L. Desai, A. Ficq, C. Gérard, N. Lacroix and R. Tencer have between them been investigating the action of histones on giant chromosomes of Chironomus (using ^{3}H-thymidine and ^{3}H-uridine).

Desai (cf. 6.2.1) has found that basic proteins (various fractions of histones have been tested) strongly inhibit DNA and RNA synthesis in all bands. Microinjection of trypsin into larvae has caused an increase in the size of existing puffs, and increased incorporation of uridine into the chromosomes. Tencer and Lacroix (6.2.2) have attempted a direct demonstration, of the role of nucleolar organizer in r-RNA synthesis, by autoradiography, without obtaining positive results so far.
Flicq (cf. 6.2.3) found that in Rhynchosciara ^{3}H-actinomycin tended to "colour" giant chromosomes much more uniformly than the Feulgen reaction, so that interbands may also contain DNA. Lacroix, Desai and Tencer found bandwise labelling with actinomycin in Chironomus which becomes homogeneous when RNase treatment is given.

264 Dion, A. S., Herbst, E. J. THE LOCALIZATION OF SPERMIDINE IN SALIVARY GLAND CELLS OF Drosophila melanogaster AND ITS EFFECT ON URIDINE-^{3}H INCORPORATION. Proc. natn. Acad. Sci. U.S.A. 58, 6 (1967) 2367-2371.

The autoradiographic localization of spermidine (I) and the effects of polyamines on RNA synthesis in situ in polytene chromosomes of D. melanogaster were reported. An initial decrease in RNA level during the prepupal stage was followed by a significant increase in RNA on pupation. A 2nd increase in RNA coincided with the maturation of the adult organs of the imago. The increase in polyamine content, most notably of putrescine, during the prepupal stage was followed by a decrease upon pupation. At approx. the midpupal period, i.e., when the imaginal eyes were pigmented, the prepupal polyamine levels were re-established. Upon eclosion, the level of putrescine dropped markedly, and concurrently small increases in the levels of I and spermine were observed. I at 5.0×10^{-5} and 10^{-4} M substantially inhibited ^{3}H-labelled uridine incorporation into the nuclei in salivary gland cells of D. melanogaster. I, at 6.4×10^{-4} M, produced concomitant changes in nuclear structures. All spermine concentrations investigated ($0.29 - 4.6 \times 10^{-4}$ M) strongly inhibited the incorporation of ^{3}H-labelled uridine. Although the nuclear to cytoplasmic labelling ratio of tritiated I in distal cells of the salivary gland is approx. 2, the label appears uniformly distributed in proximal cells. (CA 68: 1968, 47373r)

265 Durand, M., Favard-Sereno, C. NUCLEIC ACID METABOLISM DURING OVOGENESIS IN CRICKETS, Gryllus bimaculatus. p.331-335 of the "5th Symp. Int. Hist., Histochim. Cytochim. Lipides. Sofia, 1963". Published 1966.

Autoradiography of eggs of G. bimaculatus, labelled with thymidine-^{14}C and adenine-^{14}C show 30% of the cells are synthesising DNA. Traces of radioactivity were observed in the cytoplasm just before cessation of follicle epithelial activity. Analysis shows $9-12 \times 10^{-3}$ µg of DNA/egg compared to 5.7×10^{-6} µg/haploid sperm, confirming the occurrence of endomitosis. The A/T ratio of DNA of eggs plus follicle cells is 0.58, of eggs alone 0.38, and 1 in the DNA of testicles. The low egg ratio increases during embryonic development to 1 at the blastula stage. Autoradiography shows that RNA is synthesised by 5 d on chromosomes, passing to nucleoli and cytoplasm in 40 d. RNA is transferred from follicle cells to the oocyte. (CA 68: 1968, 66851p)

266 Erdström, J. E., Daneholt, B. SEDIMENTATION PROPERTIES OF THE NEWLY SYNTHESIZED RNA FROM ISOLATED NUCLEAR COMPONENTS OF Chironomus tentans SALIVARY GLAND CELLS. J. molec. Biol. 28, 2 (1967) 331-343.

^{2}H-uridine and ^{3}H-cytidine were used. Sedimentation analyses of labelled RNA from isolated nuclear components of C. tentans salivary gland cells are presented. It is shown that nucleoli form a 38 S component which is converted to one 30S and one 20S component. The 30S fraction is probably composed of the heavy ribosomal RNA fraction and an intermediate precursor, slightly larger than 30S. The finished light ribosomal 17S RNA molecule, to which the 20S component is believed to be a specific intermediate precursor, was never observed in the nucleolus. Label due to preribosomal and ribosomal components was absent from chromosomes and nuclear sap. The nucleoli do not form a labelled 4S RNA peak, in contrast to chromosomes and nuclear sap. The distribution of 4S RNA label among the chromosomes suggests its formation from a large number of loci. The chromosomes also produce polydisperse RNA in the sedimentation range of 10 - 90S. The polydispersity is not a function of heterogeneity in band origin but is found in the RNA of the single Balbiani ring. The polydisperse RNA has a sedimentation range that is higher than that reported for messenger RNA. (Essentially auth.)

267 Ermokhina, T.M., Mekhanik, M.L., Zaitseva, G.N., Belozerskiĭ, A.N. PHENYLALANYL-RNA SYNTHETASE AND PHENYLALANINE SOLUBLE RNA (s-RNA) IN YEAST AND INSECTS. Dokl. Akad. Nauk SSSR 170, 4 (1966) 974-977.

RNA synthetases from fly larvae and yeast were fractionated on DEAE-cellulose columns. The insect-derived aminoacyl-RNA synthetase gave two phenylalanyl-synthetases, E_1 and E_2, differing in eluability by aqueous NaCl, which corresponded to the 2 phenylalanine types of s-RNA in the fly larvae, as shown by aminoacylation with phenylalanine-^{14}C. The yeast-derived synthetase material gave but one fraction of active enzyme in E_3 fraction eluted from DEAE-cellulose by aqueous NaCl. This was identical with the 1st fraction of phenylalanine type of s-RNA of the fly larvae. Thus, there is a universal type of phenylalanine s-RNA. The other insect RNA-synthetase was apparently specific for the insect. (CA 66: 1967, 35659m)

268 Eudy, W.W., Dobrogosz, W.J. RADIOISOTOPE INCORPORATION AND NUCLEIC ACID SYNTHESIS IN DIPTERAN EMBRYOS. J. Cell. Biol. 35, 2 Pt.2 (1967) 37A. Abstr.73. "7th Annual Meeting of the American Society for Cell Biology. Denver, Colo., USA, 13-15 Nov.1967".

Owing to the fact that dipteran insect embryos are closed systems and exhibit high impermeability to water-soluble metabolites, it was difficult in the past to determine the biochemical changes that occur during embryogenesis in these organisms. Studies in our laboratory with Phormia regina have shown that these difficulties can be overcome, and that isotopically labelled metabolites can in fact be used in studying dipteran embryo development. Eggs are collected for 1 h, sterilised and dechlorinated with NaOCl, transferred with sterile Ringer's solution to flasks containing sodium lauryl sulfate, and then vigorously aerated by shaking during the entire developmental period. Viability is high and good synchronous development is obtained. Aqueous solutes such as ^{3}H- or ^{14}C-leucine, -uridine, -thymidine, and -glucose, and $^{32}P_i$ are readily taken up, and, as indicated by chemical fractionation experiments, are assimilated into the expected macromolecular components. With this information at hand, studies were undertaken to delineate the nature of nucleic acid formation in these embryos. The embryos were incubated with ^{3}H-uridine, ^{3}H-thymidine, or $^{32}P_i$ for various periods. This was followed by extraction of the nucleic acids with phenol and purification by alcohol precipitation and chromatography on columns of methylated albumin-kieselguhr. The oligonucleotide fraction was rapidly labelled at all stages of development. The synthesis of soluble RNA and ribosomal RNA, however, did not occur until approx. 25% of the total development period (18 h) had elapsed - a time corresponding approx. to the onset of gastrulation. A nucleic acid fraction containing ^{3}H from both ^{3}H-uridine and ^{3}H-thymidine was detected during the early stages of nucleic acid synthesis and presumably represents RNA-DNA hybrid material. The formation of β-galactosidase and the pattern of protein biosynthesis were also measured in this system. (Abstr.)

269 Firshein, W., Berry, S.J., Swindlehurst, M. THE BIOSYNTHESIS OF DNA BY INSECTS. I. THE UTILIZATION OF DEOXYCYTIDINE BY DEVELOPING ADULTS OF THE CECROPIA SILKWORM. Biochim. biophys. Acta 149, 1 (1967) 190-198.

The pathway of deoxycytidine utilization was investigated in developing pupae of Hyalophora cecropia. The following intermediates were identified in a single assay system starting with deoxycytidine: deoxyuridine, deoxyuridine monophosphate, thymidine monophosphate, thymidine diphosphate, and thymidine triphosphate. The existence of this pathway was confirmed in several ways in addition to the detection of the actual intermediates. First, injection of [^{14}C]deoxycytidine or [^{14}C]deoxyuridine into developing pupae resulted in the localization of the label in the thymine moiety of DNA and no significant radioactivity was detected in the cytosine moiety. Second, omission of various components from the complete assay system produced a predictable loss of certain intermediates. Third, the activity of other enzymes which might compete with this pathway were not detected or detected in trace amounts, e.g., deoxycytidine monophosphate deaminase, deoxycytidine kinase, thymidine synthetase, deoxyuridine monophosphate kinase and deoxycytidine degradative enzymes. The enzyme which converts deoxyuridine monophosphate to deoxythymidine monophosphate (thymidylate synthetase) was not detected in diapausing or injured diapausing pupae, but was present in significant amounts in developing pupae. The injection of [^{14}C]thymidine into developing pupae also resulted in the association of the radioactivity with DNA-thymine, but little or no thymidine kinase activity could be detected in the extracts. (Auth. summary)

270 Gabrusewycz-Garcia, N., Kleinfeld, R.G. A STUDY OF THE NUCLEOLAR MATERIAL IN Sciara coprophila. J. Cell Biol. 29, 2 (1966) 347-359.

In the polytene chromosomes of S. coprophila, in addition to a nucleolus, large numbers of nucleolar-like structures or micronucleoli are formed. A detailed mapping localized the nucleolar organizer at one end of the X-chromosome and revealed that ~18% of the bands of each chromosome are potentially capable of producing micronucleoli. Most of these sites are in regions known from a previous study to show asynchronous DNA replication: DNA puffs and certain heterochromatic regions. Micronucleoli are rarely found in association with bulbs. The RNA metabolism of the polytene chromosomes during late 4th instar was studied using radioautographic techniques. Isolated glands were incubated in ^{3}H-uridine for 10 - 30 min, and radioautographs were made of crushed preparations. Despite the wide range of variation found among different larval cultures, the following pattern was observed. Just prior to and at the beginning of DNA puff formation, a period of intense extrachromosomal nucleolar and micronucleolar RNA synthesis occurs. After max. development of the DNA puffs, the synthesis of extrachromosomal RNA is at a low point, while incorporation into bulbs and DNA puffs remains high. With the onset of the prepupal stage, all nuclear RNA synthesis ceases. (Auth.)

271 Gabrusewycz-Garcia, N. CYTOLOGIAL AND AUTORADIOGRAPHIC STUDIES ON Sciara coprophila SALIVARY GLAND CHROMOSOMES. Diss. Abstr. 27, 12 Pt. I (1967) 4246-B.

Detailed revised cytological maps of the three autosomal salivary elements of S. coprophila were prepared, using several distinct larval stages from mid 4th to late 4th instar. The sites of DNA puffs and bulbs, as well as their extent at maximal development were determined and represented in these maps. A method of evaluating the age of larvae within the last 3 - 4 d of 4th instar was worked out by means of eyespot size determinations (counts). This is particularly important since the eyespot sizes are correlated with the development of the salivary gland nuclei in which dramatic changes in puffing pattern occur within a short period of time during these stages. The positions of the centromere regions in salivary chromosomes of S. coprophila were confirmed by observing special replicative features of these regions. High resolution autoradiography was used to follow ^{3}H-thymidine incorporation into DNA of salivary gland chromosomes of larvae from the last 5 - 6 d of 4th instar. Earlier studies in Sciara indicated an all-or-none type of chromosomal replication. However, we observed differential labelling of bands and groups of bands. The centromere regions, certain chromosomal ends, as well as a number of deeply-staining bands showed a parallel behaviour in replication and form one group designated group C. The second group P includes a number of light-staining bands, bulbs, and, depending on the stage of development, either the puffs or the pre-puff sites. These two groups show a markedly different behaviour in relation to precursor uptake. When group C shows a high rate of incorporation, group P shows no incorporation, and vice versa. However, during a considerable part of the replication period, most or all of the bands display uniform labelling (pattern E). Pattern E is found with high frequency in relation to the other two. From extensive observations on these replication patterns, we have constructed a probable sequence of P → E → C. A statistical procedure was chosen to demonstrate the existence of the two patterns of unequal labelling. It is significant to note that in Sciara all chromosomes from the same nucleus show the same pattern. They are either a) all uniformly labelled (pattern E), b) all show the C pattern, or c) all show the P pattern. Replication patterns occurring at the time of DNA puff formation are easily followed, since a large proportion of the nuclear population is undergoing DNA synthesis at this time. The sequence of patterns at this stage differs from that of the earlier replication in that the C pattern fails to occur and also in that the P sites show incorporation continuously; they are not only the first but also the last sites to incorporate the isotope. There are several cytological criteria by which the so-called "heterochromatin" may be identified. Using all of these criteria bands of group C may be considered as heterochromatic. (From DA)

272 Garcia, F. J. T. ESTUDIO DE LA FRECUENCIA DE LETALES EN DIFERENTS LICALIDADES DEL DISTRITO FEDERAL EN Drosophila melanogaster Y ALELISMO. (Study on the frequency of lethals in Drosophila melanogaster encountered in different locations, and on allelism.) Thesis, Universidad Nacional Autonoma de Mexico, Mexico City. 1967, 38p. (In Spanish)

In order to determine which of two autosomes carry the lethal gene the chromosomes were isogenized. This consists of producing a homozygous individual from a heterozygous one by means of the chromosome balance, when the lethal factor is manifested. Two x-ray-induced translocations, Cy/Pm in chromosome II and Ubx/Sb in III, were used. In order to analyse the wild flies, an isogenization process was applied to each of the captured individuals, and chromosomes II and III were studied. From the experimental data obtained, the occurrence of recessive lethal and semilethal autosomic genes could be deduced in the heterozygous state in chromosomes II and III of D. melano-

gaster in the various localities studied in the Federal District of Mexico. By comparing the occurrence of lethal and semilethal genes in localities far apart and also in localities close to one another, a balance in the population dynamics of D. melanogaster could be deduced. The mean results obtained indicate a greater incidence of lethal and semilethal genes in chromosome II. The causes of this greater incidence are unknown. Due to the fact that the techniques applied in this experiment differ from those used in other parts of the world, the findings obtained in Mexico cannot be compared with any others, but it may be concluded that even under different climatological conditions the same lethal mutations exist in various wild populations throughout the world.

273 Gaudecker, B. von. RIBONUCLEIC ACID SYNTHESIS IN THE NUCLEOLUS OF Chironomus thummi (Tendipes thummi), AS STUDIED BY HIGH-RESOLUTION AUTORADIOGRAPHY. Z. Zellforsch. mikroskop. Anat. 82, 4 (1967) 536-557. (In English)

Full-grown 4th-instar larvae of T. thummi were injected with uridine-^{3}H, and the salivary glands were fixed after 13 min - 46 h. Autoradiographs of sections examined in the light and electron microscopes showed a transposition of label from the pars fibrosa to the pars granulosa of the nucleolus. After short uridine incorporation, label was also found over chromosomal material, extending into the nucleolus. The label over the nucleolus organizer, extending into the nucleolus, indicates ribosomal RNA synthesis at these chromosomal sites. This RNA, which is first located in the pars fibrosa, subsequently breaks down within the nucleolus into two different components which combine with protein. After 20 min the smaller of these RNA particles (40 S) is found in the cytoplasm, whereas the bigger one (60 S) migrates to the pars granulosa of the nucleolus. With time these appear in the cytoplasm, combining with the 40 S particles to form the functional ribosomes. (CA 68: 1968, 47428p)

274 Gaulden, M. E., Jones, G. A., III. EXPERIMENTAL CONTROL OF NUCLEIC ACID SYNTHESIS IN INDIVIDUAL DIVIDING CELLS. J. Cell Biol. 31, 2 (1966) 38A. Abstracts of Papers Presented at the "6th Annual Meeting of the American Society for Cell Biology, Houston, Tex., USA. 17-19 Nov. 1966". Abstr. 73.

Chromatin of living neuroblasts of the grasshopper embryo, Chortophaga viridifasciata de Geer, is visible in some form throughout the entire cell cycle. At interphase, prophase, and telophase, it can be quickly and reversibly condensed by culture medium hypertonic to the cells or extended by medium hypotonic to them. Synthesis of both DNA and RNA (uptake of ^{3}H-thymidine and ^{3}H-uridine, respectively) is known to begin in the neuroblast at the mid-point of telophase; DNA synthesis ends in very early prophase and RNA synthesis continues into mid-prophase. Radioautographs of neuroblasts exposed to media of varying tonicity containing ^{3}H-thymidine (^{3}HT) reveal the following points. (1) If cells are placed in hypertonic medium at a stage immediately preceding the beginning of DNA synthesis (anaphase or early telophase), initiation of synthesis is prevented as long as the chromatin is kept in a condensed state (control cells in labelled isotonic medium for comparable times progress into the synthesis period). (2) If the cell has just begun DNA synthesis (mid-telophase) before being placed in hypertonic medium, a very small amount of ^{3}HT uptake is observed. (3) If a cell is well into the synthesis period (late telophase or interphase) when the chromatin is condensed by hypertonic medium, uptake of ^{3}HT is reduced by about 50%. Results are reported of experiments in progress, designed to determine whether the extension of mid- and late prophase chromatin by hypotonic medium to a state resembling interphase chromatin is accompanied by ^{3}HT uptake and whether RNA synthesis is affected by tonicity-induced changes in the physical state of chromatin.

275 Gaulden, M. E. INFLUENCE OF THE PHYSICAL STATE OF CHROMATIN ON NUCLEIC ACID AND PROTEIN SYNTHESIS AND ON RADIATION SENSITIVITY OF CELL DIVISION. Progress Report, ORO-3546-3, Texas Univ., Dallas. Southwestern Medical School. 24 Feb. 1967, 12p.

Eggs of grasshoppers (Chortophaga) were subjected to temperatures of 3 - 4°C; embryonic growth was stopped, and after six months of storage the eggs failed to hatch. New techniques for making serial paraffin sections of grasshopper embryos and techniques for making autoradiographs of ^{3}H-thymidine labelled chromosomes of neuroblast cells were developed. The degree of expansion of condensation of the chromosomes in relation to DNA synthesis is discussed. The effects of colchicine on RNA metabolism are being studied. Immunological studies on rapidly dividing neuroblast cells are being conducted. (NSA 21: 1967, 22241)

276 Gay, H. ORGANIZATION OF CHROMOSOMES IN HIGHER FORMS. Carnegie Institution of Washington. Cytogenetics Laboratory. Carnegie Inst. Wash. Yb. 64 (1964/65) 537-552.

In one section the fine structure of chromosomes, the development of salivary-gland chromosomes, and the perichromatin in vesicles of Tradescantia mitotic chromosomes are discussed. A further section is devoted to the mitotic cycle and DNA replication in Haplopappus gracilis, another to the DNA of mitotic chromosomes of Drosophila (p. 546-547); radioautographic analysis now in progress of ^{3}H-thymidine incorporation into mitotic chromosomes of neuroblast cells of D. melanogaster may give a value to the origin of their polynemic nature. The base composition of heterochromatic DNA in D. melanogaster is examined (p. 548-550).

277 Greenberg, J. R. SEDIMENTATION STUDIES ON Drosophila virilis SALIVARY GLAND RNA. J. Cell Biol. 35, 2 Pt.2 (1967) 49A-50A. Abstr. 99, "7th Annual Meeting of the American Society for Cell Biology. Denver, Colo., USA. 13-15 Nov. 1967".

RNA synthesised by salivary glands of 3rd-instar larvae or prepupae incubated in an artificial culture medium containing ^{3}H-uridine has been compared with RNA from whole larvae of similar age labelled by injection of ^{3}H-uridine. RNA was extracted by cold phenol-SDS and examined by sucrose density gradient zonal centrifugation. Drosophila RNA having major components of about 28S, 18S, and 4S was used as a marker. The first distinct component labelled in whole larvae sedimented at 38S. Label next appeared simultaneously in 30S and 18S components, and eventually in a 28S component, together with a relative decline in the 38S and 30S components. By 4 h, only 28S, 18S, and 4S RNA were labelled. It seems probable that the 38S molecule is the precursor of the 30S molecule and 18S ribosomal RNA, the 30S molecule being in turn the precursor of 28S ribosomal RNA. RNA from isolated salivary glands labelled for 15 min also showed a peak at 38S, the remainder being polydisperse and as fast as 70S. Upon further incubation, label appeared in a 30S component, but radioactivity peaks coinciding with the 28S and 18S OD peaks were never obtained. The radioactive salivary gland RNA was always polydisperse, although the proportion of heterogeneously sedimenting RNA was diminished by transferring labelled glands to "chase" medium for 3 h. Upon prolonged labelling, or labelling followed by a chase, a relatively stable 32S peak which is presumably an intermediate in ribosomal RNA formation was found in salivary gland RNA, although this component was not detected in whole larval RNA. It is concluded that salivary glands labelled in vitro make ribosomal precursor RNA, but not finished ribosomal RNA. Apparently, the fraction of the 38S molecule normally destined to become 18S ribosomal RNA is degraded, while a remaining fraction accumulates as a 30S molecule. However, salivary glands in vivo make ribosomal RNA normally.

278 Greenberg, J. R. DEVELOPMENTAL VARIATION IN THE UPTAKE OF A RNA PRECURSOR BY Drosophila virilis SALIVARY GLANDS. J. Cell Biol. 35, 2 Pt.2 (1967) 167A-168A. Abstr. 346. "7th Annual Meeting of the American Society for Cell Biology. Denver, Colo., USA. 13-15 Nov. 1967".

The kinetics of incorporation of ^{3}H-uridine into salivary glands at mid to late 3rd instar (feeding stage) and prepupa has been examined. Incorporation was measured by removing explanted glands at intervals from an artificial culture medium containing the labelled precursor and counting cold trichloroacetic acid-insoluble radioactivity. Results were expressed as cpm per salivary gland, cpm/µg protein, or cpm/µg DNA. The last method was the most satisfactory. 3rd-instar glands showed kinetics which were linear, or of a higher order, for 90 min or more (3 of 3 experiments). Prepupal glands showed an initially higher rate of incorporation, but the rate decreased rapidly after 30 min (10 of 11 experiments). It is thought that the kinetics of incorporation into the prepupal glands represents an approach to a steady state of RNA synthesis, rather than a cessation of synthesis, for the following reasons: (1) The same kinetics was obtained regardless of how long the glands were kept in vitro before labelling (2-4 h). (2) Glands kept in vitro as long as 20 h before labelling incorporated readily. (3) If glands were labelled, then placed in medium containing unlabelled nucleosides or actinomycin D, there was a decline in the level of trichloroacetic acid-insoluble radioactivity. When RNA made in vitro at both stages was examined by sucrose gradient centrifugation, no consistent differences were found between them after either 15 min or 3.5 h of labelling. Both stages made much heterogeneously sedimenting RNA and precursors of ribosomal RNA, though neither made finished ribosomal RNA. The kinetics observed for prepupal salivary glands may be explained by one or more of the following possibilities: (1) an increase in the rate of synthesis of unstable heterogeneously sedimenting RNA; (2) a decrease in the rate of synthesis of normally stable RNA species – ribosomal and transfer; (3) a decrease in the stability of usually stable RNA species. (Abstr.)

279 Grell, R.F. DNA REPLICATION AND CROSSING-OVER IN THE Drosophila OOCYTE. p.85 of "Research and Development in Progress - Biology and Medicine. Issue No.4". TID-4204, Division of Biology and Medicine (AEC), Washington, D.C. Apr.1966, 229p. Abstr. BIA 2589.

^{3}H-thymidine to be used in the autoradiographic part of the study.

280 Gruzova, M.N. THE ROLE OF THE NUCLEUS IN RNA AND PROTEIN METABOLISM OF THE Chrysopa perla OOCYTES. Tsitologiya 8, 6 (1966) 713-718. (In Russian)

Autoradiographic experiments on the incorporation of adenine-^{14}C, phenylalanine-^{14}C, and tyrosine-^{14}C were undertaken to explain the role of the oocyte nucleus in the RNA and protein metabolism in ovarioles of C. perla. In the shortest time intervals of incubation (5 and 15 min) adenine-^{14}C was incorporated mainly in the oocyte nuclei. After 1 h the oocyte cytoplasm became radioactive. The most intense incorporation of oocytes coincided with the period of fragmentation of the nucleoli in the middle and later stages of previtellogenesis. Tracers were not observed in the karyosphere. Tyrosine-^{14}C and phenylalanine-^{14}C were observed to be incorporated both in the oocyte cytoplasm and in the oocyte nuclei at 15, 30, and 60 min. The most active stages in the incorporation of amino acids were also seen to be the middle and late stages of previtellogenesis. The nucleoli of young oocytes did not incorporate these amino acids. It was assumed that the karyosphere incorporated the protein precursors like the karyolymph, without any specific accumulation of these precursors. (CA 66: 1967, 73640f)

281 Hansen-Delkeskamp, E., Sauer, H.W., Duspiva, F. RIBONUCLEINSÄUREN IN DER EMBRYOGENESE VON Acheta domestica L. (Ribonucleic acids in the embryogenesis of Acheta domestica L.) Z. Naturf. 22b, 5 (1967) 540-544. (In German)

The total RNA contents (~0.1 µg/embryo) were extracted from cricket embryos by means of the sodium dodecylsulphate - phenol method and separated by zone gradient centrifugation. Hardly any labelling of RNA could be observed in the synchronous cleavage stages, following $^{14}CO_2$-incubation of 0.5 g-eggs. Incorporation of rRNA (~10 S-fraction) begins simultaneously in the heterochronous cleavage divisions and coincides with the prolongation of interphase, the occurrence of nucleoli and the appearance of cleavage nuclei in the posterior portion of the egg. A net synthesis of rRNA only occurs during the formation of the basic physical features. During the period of development under consideration the 18 S-rRNA always clearly showed a much higher rate of $^{14}CO_2$-incorporation than the 28 S-rRNA.

282 Harris, S.E., Forrest, H.S. RNA AND DNA SYNTHESIS IN DEVELOPING EGGS OF THE MILKWEED BUG, Oncopeltus fasciatus (Dallas). Science, N.Y. 156 (1967) 1613-1615.

[^{3}H-5T]-uridine (23.0 Ci/mM) and [^{3}H-6T]-thymidine (14.5 Ci/mM) were used to study RNA and DNA synthesis, respectively. Ribosomal RNA synthesis in developing eggs of O. fasciatus was turned on at gastrulation (44 h). A rapid burst of ribosomal RNA synthesis occurred during the 68 - 118 h period, when almost all of this type of RNA found in the 188-h-old egg was synthesised. Synthesis was essentially turned off with the beginning of organogenesis ~72 h later. The pattern for DNA synthesis is similar although less pronounced. The rate of DNA synthesis in the 20-h blastula stage is high but does not account for the increase in DNA and cell numbers which occurs then. From gastrulation up to 92 h, DNA is synthesised at a constant rate which decreases, subsequently.

283 Heinonen, L., Halkka, O. EARLY STAGES OF OOGENESIS AND METABOLIC DNA IN THE OOCYTES OF THE HOUSE CRICKET, Acheta domesticus. Annls Med. exp. Biol. Fenn. 45, 1 (1967) 101-109.

The development and metabolism of a spherical Feulgen-positive body (FPB) was investigated in the early stages of oogenesis in the house cricket, A. domesticus. The FPB is first seen in premeiotic interphase and begins to disintegrate in diplotene. Features of its metabolism and especially its mode of disintegration suggest that the FPB contains metabolic DNA. Thymidine is incorporated into the oocyte nucleus only at preleptotene and leptotene. The chromosomal DNA synthesis begins and is completed slightly earlier than that of FPB, but they partially overlap in time. The FPB of Acheta forms micronucleoli and releases them into the nucleoplasm. The micronucleoli incorporate tritiated uridine and presumably synthesise ribosomal RNA. A hypothesis to explain the kinetics of rapid vitellogenesis in Acheta is presented. (CA 67: 1967, 71419n)

284 Hennig, W. CHROMOSOMENFORSCHUNG UND GENPHYSIOLOGIE. (Chromosome research and gene physiology.) Umschau 66, 13 (1966) 435-437. (In German)

Short review article, essentially of work on the giant chromosomes of Chironomus tentans. The usefulness of autoradiographic methods is evident in the study of DNA content of the chromosomes, the puffing phenomenon and its relation to RNA synthesis, the characterization of the newly synthesised RNA (messenger-, transfer-, and ribosomal RNA) and its role in protein synthesis, DNA and protein synthesis, regulation processes and gene localization.

285 Hennig, W. UNTERSUCHUNGEN ZUR STRUKTUR UND FUNKTION DES LAMPENBÜRSTEN-Y-CHROMOSOMES IN DER SPERMATOGENESE VON Drosophila. (Study on the structure and function of the lampbrush Y-chromosome in Drosophila.) Chromosoma 22, 3 (1967) 294-357. (In German, with English summary)

The following labelled precursors were used: ^{3}H-uridine (specific activity 13.0 - 31.0 Ci/mM), ^{3}H-cytidine (27.2 Ci/mM), ^{3}H-thymidine (7.2 and 15.0 Ci/mM), ^{3}H-L-histidine (38.1 Ci/mM), ^{3}H-D/L-leucine (10.9 Ci/mM), and D/L-leucine-1-^{14}C (36.6 mCi/mM). For single labelling 0.1 µl of a mixture of 2 µCi ^{3}H-uridine and 2 µCi ^{3}H-cytidine or 3 µCi ^{3}H-D/L-leucine/µl Drosophila Ringer were used. For double labelling for simultaneous measurement of RNA and protein synthesis 1 µl of a solution of 3 µCi ^{3}H-uridine + 3 µCi ^{3}H-cytidine + 1 µCi ^{14}C-D/L-leucine in 1 µl Drosophila Ringer were injected. Incorporation studies with radioactive precursors have shown that the lampbrush-like loops of the Y-chromosome in the spermatocytes of D. hydei contain axial DNA and actively synthesise RNA. Uridine-incorporation, at least in some of the loops, appears to be polarized. In most of the loops, the amount of the label increases with incubation time. Studies of the life cycle of spermatocytes indicate that labelled RNA is stored in the loops for about 20 - 30 h, while the loops themselves persist for about 120 h. Following incubation with labelled amino acids, an uptake of labelled proteins from the cytoplasm into the nucleus was observed. The labelled nuclear proteins apparently leave the nucleus within a few hours, without long-term binding to the Y-structures, for even a 40-h incubation does not result in preferentially labelled Y-structures. These data, along with data on the action of antimetabolites, suggest that the Y-structures are dynamic structures: their form seems to be maintained by an equilibrium between the accumulation and outflow of matrix material surrounding the DNA axis. The possible role of the functional structures of the Y-chromosome for messenger utilization in the postmeiotic stages of spermiogenesis is discussed.

286 Horikawa, M., Ling, L. L., Fox, A. S. EFFECTS OF SUBSTRATES ON GENE-CONTROLLED ENZYME ACTIVITIES IN CULTURED EMBRYONIC CELLS OF Drosophila. Genetics 55 (1967) 569-583.

Active RNA and DNA synthesis occurs in primary cultures of embryonic cells from D. melanogaster. The incorporation of ^{32}P into phospholipid, acid-soluble, and nucleic acid fractions of such cells was studied as a measure of their synthetic activities. ^{32}P was introduced in the form of carrier-free $(^{32}PO_4)^{3-}$. Such cells, when cultured in basal medium, exhibit very low levels of alkaline phosphatase, alcohol dehydrogenase, and xanthine dehydrogenase activities. During normal development, alkaline phosphatase activity reaches a peak in 3rd-instar larvae. The addition of enzyme substrates, β-glycerophosphate or phenylphosphate, to the medium has no affect on the alkaline phosphatase levels exhibited by embryonic cells in primary cultures. Alcohol dehydrogenase activity reaches a peak during the pupal period. The addition of ethanol to the medium in appropriate concentrations has no marked effect on the growth rate of embryonic cells, but results in a doubling of alcohol dehydrogenase activity. Methanol has a similar, although less marked, effect. The response of cultured cells to the addition of ethanol is rapid, and removal of ethanol from the medium results in a rapid decline in alcohol dehydrogenase activity. Alkaline phosphatase and xanthine dehydrogenase levels are not affected. Xanthine dehydrogenase reaches a peak in adults. The addition of hypoxanthine, xanthine or uric acid to the medium results in a significant depression of xanthine dehydrogenase activity extractable from cultured embryonic cells. Studies with larval enzyme demonstrate that uric acid is a noncompetitive inhibitor of xanthine dehydrogenase, suggesting that the depression of enzyme activity in embryonic cells by hypoxanthine and xanthine results from their conversion to uric acid and enzyme inhibition.

287 Howard, E. F., Plaut, W. ORDERED CHROMOSOMAL DNA SYNTHESIS IN Drosophila melanogaster. J. Cell Biol. 35, 2 Pt. 2 (1967) 59A. Abstr. 119. "7th Annual Meeting of the American Society for Cell Biology. Denver, Colo., USA. 13-15 Nov. 1967".

DNA synthesis has been studied in three polytene chromosome segments from the larval salivary gland of D. melanogaster. The segments are the distal one-fifth of chromosomes 2 R, 3 L, and X. Each segment contains cytological regions or replicons whose individual DNA synthetic activity can be resolved radioautographically from that in adjacent replicons. When excised salivary glands are exposed for short periods of time to ^{3}H-thymidine, different combinations of replicons are labelled in different nuclei. Each unique combination of labelled replicons in a chromosome segment constitutes a labelling pattern. Two kinds of analysis of all the patterns observed in individual chromosomes and all the combinations of patterns observed in more than one chromosome in single nuclei reveal that the DNA synthetic activity of the chromosomal replicons is coordinated. First, it is shown statistically that the various patterns and combinations of patterns could not be produced with the observed frequencies by the random association in single nuclei of independently replicating replicons. Second, if it is assumed that once DNA synthesis begins in a replicon it goes to completion without stopping, the various patterns and combinations of patterns can be arranged in ordered arrays which reflect the temporal sequence of DNA synthesis among chromosomal replicons. These arrays predict that in any one chromosome DNA replication begins and ends at very few loci and that simultaneous synthesis at a larger number of points occurs at an intermediate time. The chromocentre is resolvable as a unit of DNA synthesis in radioautographs. Labelled chromocentres can be seen in nuclei which contain unlabelled chromosome arms. However, labelled chromosome arms are never seen with unlabelled chromocentres. It is concluded that the time span of DNA synthesis in the chromocentre is longer than that in the chromosomal replicons. (Abstr.)

288 Ilan, J., Ilan, Judith, Quastel, J.H. EFFECTS OF ACTINOMYCIN D ON NUCLEIC ACID METABOLISM AND PROTEIN BIOSYNTHESIS DURING METAMORPHOSIS OF Tenebrio molitor. Biochem. J. 100, 1 (1966) 441-447.

Injection of 0.16 µg of actinomycin D into pupae of the beetle T. molitor, results in the development of modified adults in which the head and thorax are essentially adult, while the abdomen and wings remain pupal-like. It is suggested that the messenger RNA for the development of head and thorax is present in the animal from first day of pupation. Injection of 0.16 µg of actinomycin D brings about 51-67% inhibition of labelled uridine incorporation into RNA. When thymus DNA is mixed with actinomycin D before injection into pupae the latter develop into normal adults. This protection does not occur when DNA and actinomycin D are injected separately. The inhibition of incorporation of labelled uridine into RNA by actinomycin is diminished to some extent when DNA and actinomycin D are injected separately, and abolished if they are injected together. Inhibition of RNA synthesis by actinomycin D in vitro is fully reversible. DNA or deoxyguanosine can reverse the effect of actinomycin D. Incorporation of labelled glycine into protein is not affected by actinomycin D injection during the first 6 d of pupation. On the 7th day it becomes diminished in control pupae but this effect is prevented by actinomycin D. It is suggested that the template for protein synthesis is stable during the first 6 d of metamorphosis and that on the 7th day there is a qualitative change in the protein synthesised on the template. (CA 65: 1966, 5944e).

289 International Lab. of Genetics and Biophysics, Naples (Italy). REPORT OF ACTIVITIES OF THE INTERNATIONAL LABORATORY OF GENETICS AND BIOPHYSICS, JULY 1, 1963 - JUNE 30, 1964. EUR-2589.e. 16 Aug.1965, 52p.

Some work on dipteran puff RNA synthesis involving autoradiography is also reported by the research group on animal genetics.

290 Ishizaki, H. PUFFING (OF SALIVARY GLAND CHROMOSOMES). Tampakushitsu Kakusan Koso 11, 11 (1966) 946-951. (In Japanese)

A review with 22 references. The title phenomenon is peculiar to Diptera insects. In the puffing state, DNA becomes diffuse and RNA becomes dense.* This is discussed in relation to the development of insects. (CA 68: 1968, 10606v).

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* It is assumed that radioisotope studies are considered here. (It was not possible to consult the original.) (Compiler's note).

291 Jacob, J. AN ELECTRON MICROSCOPE AUTORADIOGRAPHIC STUDY OF THE SITE OF INITIAL SYNTHESIS OF RNA IN THE NUCLEOLUS OF Smittia. Expl Cell Res. 48, 2 (1967) 276-282.

The study was carried out on explants of salivary glands from late larvae. These were incubated for 10 - 12 min in Morgan Morton and Parker's medium 199 with added ^{3}H-uridine (100 µCi/ml, specific activity 3.0 Ci/mM), fixed in (4°C) 6.5% glutaraldehyde in phosphate buffer at pH 7.5, the glands being subsequently embedded in glycol methylate and silver sections mounted on carbonized formvar-coated Ni-grids, and covered with an Ilford L4 nuclear emulsion. Results from pulse labelling are consistent with the interpretation that in the salivary gland cells of the late larval stage of Smittia, the synthesis of nucleolar RNA is primed by the intranucleolar DNA dispersed in the inner part of the nucleolus. From the limited evidence so far available, it is postulated that the nucleolar organizer complex may consist of an internal and an external entity. Such a distinction finds support in what appears to be a functional divisibility of the organizer. These postulates require confirmation.

292 Kaplan, W. D., Oftedal, P. GENETIC AND RADIOAUTOGRAPHIC EVIDENCE FOR A DNA-CONTAINING BODY IN THE CYTOPLASM OF THE ADULT TESTES OF Drosophila melanogaster. Genetics 56, 3 Pt.2 (1967) 569. Presented at the "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

Genetic and radioautographic studies following larval feeding with ^{3}H-thymidine or ^{3}H-deoxycytidine indicated that the genetic effects of the ^{3}H β-emmissions are confined to the nuclei of origin. On the basis of these observations one would expect that following the infection of adult males with ^{3}H-thymidine, daily brooding techniques would show a correlation between elevated mutation rates and labelled sperm heads that would appear at about the tenth postinfection day. However, this did not turn out to be so. Mutation rates above control appeared in early broods for which the sperm heads were unlabelled. Radioautographs showed, moreover, the presence of silver grains over cytoplasmic areas of the tests and also over sperm tails. This activity, by definition, derived from DNA inasmuch as the preparations had been treated by acid hydrolysis before the slides were filmed. Furthermore, the activity disappeared upon treatment with DNase but not after RNase digestion. The genetic effects arose, presumably, from the action of β-rays originating in the cytoplasm of individual spermatogonia or spermatocytes. (Abstr.)

293 Keyl, H.G. A DEMONSTRABLE LOCAL AND GEOMETRIC INCREASE IN THE CHROMOSOMAL DNA OF Chironomus. Experientia 21, 4 (1965) 191-193.

After a discussion of various data obtained by autoradiographic methods, the quantitative results of the present study are described. Microspectrophotometric measurements carried out on the salivary gland chromosomes of the cross between two sub-species of C. thummi showed differences in DNA content in homologous bands. These differences followed the relation $1 : 2^n$ (where n = 1, 2, 3 or 4). Various degrees of doubling of DNA contents were observed in certain bands. Mechanisms are discussed which might explain this duplication phenomenon.

294 Keyl, H.G. LOKALE DNS-REPLIKATIONEN IN RIESENCHROMOSOMEN. (Localized DNA replication in giant chromosomes.) p.55-68 (Discussion p.68-69) of "Probleme der biologischen Reduplikation". Sitte, P., Ed. Berlin, Springer Verlag, 1966. (In German, with English summary)

Data on the significance of localized DNA synthesis in salivary gland chromosomes of Sciara coprophila, Rhynchosciara angelae, and Glyptotendipes barbipes are reviewed. Puff formation and DNA synthesis were studied by means of ^{3}H-thymidine. In some experiments on Chironomus thummi ^{14}C-thymidine was used in addition. The possibility of a local increase in DNA content, other than during a replication phase, may be considered proved for the chromosomes of Sciara and Rhynchosciara. This type of localized increase in DNA is, however, a less general event than might be concluded from Pavan's work. The occurrence of this type of localized DNA increase (metabolic DNA) could not be confirmed for the chromosomes of Glyptotendipes. At the end of each replication phase of the giant chromosomes a number of loci of DNA synthesis can be observed. However, such local DNA synthesis is based on differential properties (DNA content) of the individual replication units. A hypothesis for the buildup of such replication units is proposed. It presents a plausible basis for the occurrence and the origin of homologous replication units of different DNA content during evolution.

295 Krishnakumaran, A., Schneiderman, H.A. DEVELOPMENT CAPACITIES OF THE CELLS OF AN ADULT MOTH. J. exp. Zool. 157, 3 (1964) 293-306

^{3}H-thymidine and -uridine were injected into adults in order to assess the rates of DNA and RNA synthesis in intact adults, in fragments of adults, and in adults grafted to various types of partners.

Biosynthetic capabilities of tissues of the short lived adults were studied using surgical, histological, and autoradiographic techniques. Adults of Samia cynthia can have their life span of 11 d prolonged to four months by parabiosing to pupal partners, which presumably supply nutrients. Parabiosis of adults or isolated abdomens to developing pupae caused supernumerary moults in the adults (sometimes two supernumerary adult-adult moults). When an adult is parabiosed to a developing pupal partner with active prothoracic glands the ecdysone produced by the developing pupae induced DNA synthesis in several tissues of the adult including the epidermis, midgut, and gonadal sheath, not just the haemocytes. The gradual decrease in RNA synthesis from emergence until death in all tissues of intact adults and isolated adult abdomens can be prevented in isolated abdomens by grafting them to isolated pupal abdomens. Many of the tissues of the adult moth are considered to have the same biochemical defect as the tissues of the diapausing pupa, i.e., an inability to synthesise DNA. In both, this defect is repaired by ecdysone.

296 Krishnakumaran, A., Oberlander, H., Schneiderman, H.A. RATES OF DNA AND RNA SYNTHESIS IN VARIOUS TISSUES DURING A LARVAL MOULT CYCLE OF Samia cynthia ricini (LEPIDOPTERA). Nature, Lond. 205 (1965) 1131-1133.

The rate of synthesis of DNA and RNA in various tissues during larval moulting of a silkmoth is described and the control of these processes examined in S. cynthia ricini, a non-diapausing saturniid moth. ^{3}H-thymidine (10 μCi/g) or ^{3}H-uridine (10 μCi/g) was injected into anesthetized larvae on each of the 7 d of the 4th instar and during the moult to the 5th- and final larval instar. Ecdysone (I) controls DNA synthesis in most larval tissues but both DNA synthesis and the rate of RNA synthesis in chitogenous epithelium. In some larval tissues like fat body, Malpighian tubules, dermal glands, nervous tissues, and chitogenous epithelium, the threshold level of I required for DNA synthesis is high, and during part of a larval instar the I titer falls so low that DNA ceases in these tissues. In other tissues (midgut and imaginal wing disks) the threshold level of I required for DNA synthesis is low and during larval life the hormone titer never falls below this threshold; hence these tissues synthesise DNA continuously and respond to increased I secretion with increased DNA synthesis. Although the haemocytes also respond to increased I with increased DNA synthesis, unlike other tissues they are capable of considerable DNA synthesis in the absence of I. The prothoracic gland RNA synthesis and cyclic secretion of hormone is under control of the brain hormone but DNA synthesis may be controlled by I.

297 Krishnakumaran, A., Berry, S.J., Oberlander, H., Schneiderman, H.A. NUCLEIC ACID SYNTHESIS DURING INSECT DEVELOPMENT. - II. CONTROL OF DNA SYNTHESIS IN THE CECROPIA SILKWORM AND OTHER SATURNIID MOTHS. J. Insect Physiol. 13 (1967) 1-57.

The present report examines factors that control the rate of DNA synthesis during larval life, metamorphosis, pupal diapause, and adult life of Cecropia and other Saturniid moths.* Autoradiographic determinations were made of the rate of incorporation of ^{3}H-thymidine in various tissues during the life history. DNA synthesis was also studied in insects subjected to diverse endocrinological and surgical manoeuvres and treated with juvenile hormone. Using labelling techniques, the careers of epidermal cells were followed from one instar to the next. In addition, various tissues were labelled with ^{3}H-thymidine, implanted into unlabelled hosts, and their developmental fate determined. DNA synthesis in adult moths was compared with DNA synthesis in other adult insects representing six orders.** The effects of a potent inhibitor of DNA synthesis on development and moulting were also analysed. During each larval moult cycle and during metamorphosis of Saturniid moths there is a definite temporal pattern of DNA synthesis in each tissue and in regions within many tissues. During larval moults in some tissues such as chitogenous epithelia, Malpighian tubules, and nervous system, DNA synthesis occurred soon after the secretion of ecdysone. In other tissues such as imaginal wing disks and muscles, DNA synthesis during larval life was not correlated with ecdysone secretion. Almost every epidermal cell appeared to synthesise DNA during every normal moult cycle, but some tissues such as Malpighian tubules and prothoracic glands did not synthesise DNA during the pupal-adult moult although they did so during earlier moults. Apparently after experiencing a moult in the absence of a high concentration of juvenile hormone these tissues differentiate and ordinarily do not synthesise DNA again. However, two experimentally induced pupal-pupal moults in the presence of juvenile hormone and ecdysone restored the capacity of pupal Malpighian tubules to synthesise DNA. In insects with a pupal diapause DNA synthesis ceased after pupation in all tissues except haemocytes and to a

* Hyalophora cecropia, Samia cynthia walkeri, S.c. ricini, and Antheraea polyphemus.

** Lepidoptera, Diptera, Coleoptera, Hemiptera, Dictyoptera, and Odonata.

small extent the gonads and fat body. This is not the result of low metabolism because the metabolic processes of a pupa could be increased up to 15-fold by integumentary injury without stimulating DNA synthesis. The absence of DNA synthesis in most tissues appears to be a fundamental characteristic of diapause and results from the absence of ecdysone. DNA synthesis was also absent in adult moths and in surgical preparations deprived of a source of ecdysone such as isolated larval abdomens, 'dauer' larvae, and non-diapausing pupae which had their brains extirpated. The addition of ecdysone stimulated DNA synthesis in many tissues of both diapausing pupae and adults. In contrast, experimental administration of brain hormone or juvenile hormone alone and in the absence of ecdysone failed to stimulate DNA synthesis in any tissues examined. Injury to the integument of a diapausing pupa provoked DNA synthesis only in epidermal cells adjacent to the wound but did not stimulate general DNA synthesis. Injury to diapausing pupae also released an 'injury factor' which stimulated DNA synthesis in haemocytes but not in other tissues. Non-diapausing insects appeared to telescope into the larval-pupal transformation a number of the changes normally associated with adult development in diapausing insects such as DNA synthesis in certain muscles and parts of the epidermis. Artificial diapause could be imposed in a non-diapausing pupa either by brain removal or by injection of mitomycin C - an inhibitor of DNA synthesis - before or after some DNA synthesis had begun in the epidermis. However, after epidermal DNA synthesis was well along, an artificial diapause could no longer be imposed. Thus injecting mitomycin C into pupae that had already initiated adult development prevented further DNA synthesis and the cell divisions necessary for scale formation, but did not block the synthesis of an adult cuticle and moulting. No adult insect among six orders examined showed DNA synthesis in epidermis, tracheae, or fat body more than 3 d after ecdysis. This absence of DNA synthesis is correlated with the absence of ecdysone, and renewed DNA synthesis can be induced with ecdysone. Adult insects which live only a short time showed no DNA synthesis in any tissues except haemocytes. However, long-lived insects such as cockroaches, mealworms, dragon flies, and the Monarch butterfly showed DNA synthesis in several tissues during adult life. The developmental fate of various cells was determined by labelling experiments. It was shown that larval epidermal cells and their immediate descendants persisted in significant numbers from one larval instar to the next. However, most pupal epidermal cells appeared to be the remote descendants of larval cells. Similarly, the developmental fate of haemocytes and fat body was determined by implanting labelled pupal cells into unlabelled pupae which were allowed to transform into adults. The relation between DNA synthesis and subsequent synthetic activities of cells differed in various kinds of insects at different developmental stages. In Saturniid moths DNA synthesis seems to be an early obligatory step in the differentiation of most epidermal cells. In other insects (e.g. Rhodnius, Oncopeltus) some larval epidermal cells form adult structures without prior DNA synthesis. In the general case, the metamorphosis of epidermal cells may or may not require DNA synthesis and may be viewed in some insects as a progressive differentiation which is punctuated incidentally by moults and DNA synthesis. Although DNA synthesis may not be necessary for the metamorphosis of certain cells it appears to be necessary for the reversal of metamorphosis. Apparently DNA replication erases certain biases and enables cells to be reprogrammed. The mechanism of action of ecdysone was examined. Experimentally induced moulting in adult silkmoths is not preceded by DNA synthesis in most epidermal cells, hence stimulation of DNA synthesis cannot be the primary effect of ecdysone even though it is an early effect in many tissues at several developmental stages. From an analysis of available data it is concluded that ecdysone should be viewed primarily as a moulting hormone that initiates biosynthetic activities which lead to moulting. Its primary effect is to stimulate the synthesis or translation of certain messenger RNA's which were previously non-existent or non-functional and which are necessary for moulting. The nature of the proteins coded by these new messenger RNA's was considered. (Auth.)

298 Kroeger, H., Lezzi, M. REGULATION OF GENE ACTION IN INSECT DEVELOPMENT. A. Rev. Ent. 11 (1966) 1-22.

This review concentrates on the phenomenon of puffing. The morphology and biochemistry of the puff is described, followed by an analysis of the sequential appearance and disappearance of puffs and of biochemical changes in the tissues as development proceeds. In a 2nd section, the experimental agents, hormonal and non-hormonal, which change puffing patterns are enumerated and their mode of action and the sequence of events leading to the appearance of specific combinations of puffs during normal development are discussed. - Numerous studies are cited in which radioisotopes had been used. - The literature survey which lists 92 references was concluded in March 1965.

299 Kulyev, P., Mamedniyazov, O.N. BIOSYNTHESIS OF NUCLEIC ACIDS IN THE SILK GLAND OF THE SILKWORM. Izv. Akad. Nauk. turkmen. SSR. Ser. Biol. No.3 (1967) 3-7. (In Russian)

The nucleic acid content in the silk gland of the silkworm increased in the 1st half of the 5th developmental stage. When enforced synthesis of silk precursors was started, the amount of nucleic acids in the gland remained constant. (CA 68: 1968, 66790t)

300 Kulyev, P., Mamedniyazov, O.N. BIOSYNTHESIS OF NUCLEIC ACIDS IN THE SILK GLAND OF THE SILKWORM. II. Izv. Akad. Nauk. turkmen. SSR. Ser. Biol. No.4 (1967) 3-9. (In Russian)

RNA synthesis was studied, utilizing centrifugation in a sucrose gradient, separation on a column of methylated albumin, and autoradiography. The incorporation rate of labelled precursors into RNA of the silkworm silk gland on various days of the 5th instar of caterpillars showed that all kinds of RNA's were synthesised during the first half of this stage. The rate of ^{32}P incorporation into RNA on the 2nd day of the 5th instar was 8-10-fold higher than before becoming a pupa. In the early stages of the 5th instar, the biosynthesis of RNA took place in the nucleus and was connected with the DNA template; during the later stages of the 5th instar, however, the incorporation of adenine involved only the exchange of terminal nucleotides in sRNA. The problem of mRNA for the synthesis of fibroin in the silk gland of the silkworm was not resolved. (CA 68: 1968, 10712b)

301 Kunz, W. ZUR CHROMOSOMENSTRUKTUR IN DEN OOCYTEN DER HEUSCHRECKE Locusta migratoria L. (Study of chromosome structure in the oocyte of the grasshopper, Locusta migratoria L.) Naturwissenschaften 53, 1 (1966) 23. (In German)

The oocyte nucleus contains α-spheres of varying sizes, presumably a part of the beaded chromosomes observed, and varying numbers of β-spheres which do not lie along such chromosomes. To date, autoradiographs taken after injecting ^3H-uridine (~0.26 μCi/grasshopper, incubated for $\geq$7.5 min) showed radioactivity to be primarily localized in the beaded chromosomes. Uridine was also incorporated by the fine threads in the nucleus, but to a lesser extent.

302 Kunz, W. FUNKTIONSSTRUKTUREN IM OOCYTENKERN VON Locusta migratoria. (Functional structures in oocyte nuclei of Locusta migratoria.) Chromosoma 20, 3 (1967) 332-370. (In German, with English abstract)

Examination of living oocyte nuclei of L. migratoria has revealed the presence of thread-like structures. They are paired and are thought to be the uncoiled chromosomes since they are broken into fragments by treatment with DNase. The greater part of the threads carries lateral loops like the lampbrush chromosomes of Amphibia. A smaller part has no loops but bears a series of conspicious granules with bright appearance under positive phase contrast optics (beaded segments). The visibility of the chromosomes has been investigated in solutions with several ions. In hypertonic media the chromosomes contract, the granules fuse, and the beaded segments become lumpy. In nitrogenous atmosphere and if kept at low temperature the beaded structures are also transformed into several lumps. After return to normal conditions they reconstitute their characteristic beaded appearance. In autoradiographs obtained by injection of ^3H-uridine (specific activity up to 24 400 mCi/mM, 0.3 mCi/ animal) into the body cavity and by incubation of isolated nuclei in vitro, rather uniformly distributed labelling occurs in the oocyte nuclei for up to 30 min incubation time. With prolonged incubation the activity of the beaded segments becomes more intense than the labelling of the lampbrush chromosomes. After treatment with actinomycin RNA synthesis stops, the axes of beading and the lampbrush chromosomes contract, and the granules disappear more and more. The beaded structures may have nucleolar function in Locusta as they have in Amphibia. If so, the only difference from the Amphibian nucleoli would be the continued attachment to the lampbrush chromosomes. (From abstr.)

303 L'Helias, C. INDUCTION DE DESORDRES TISSULAIRES CHEZ LES INSECTES PAR ALTERATION DE L'EQUILIBRE ENTRE FACTEURS DE CROISSANCE PTERINIQUES ET HORMONES DE CROISSANCE ET MECANISME DE CETTE INDUCTION. (Induction of tissue disorders in insects by altering the equilibrium between pterinic growth factors and growth hormones, and the mechanism of this induction.) Annals Endocr. 27 Suppl. 3 (1966) 343-352. (In French)

The injection of a pterinic growth factor (folic acid) to insects in diapause in hormone-deficient conditions induces the formation of tumours. From these tumours, artificially induced in chrysalids of Pieris brassicae, a factor causing tumours is extracted, which can be isolated by centrifugation. It

is infectious to other species when given by injection and is transmissible hereditarily. A study of Drosophila shows that it is transmitted through the cytoplasm by modification of sex ratio: reduction of the ♂ which (carry ?) the lethal tumours. Experiments proved that the factor induced by the pterines is made up of light particles which contain DNA. It is DNA which is the active constituent. This DNA, labelled by ^{3}H-thymidine, is run on a sucrose gradient at 25 000 rpm. The radioactive and biologically active factor is a 4S component after the breakdown of light particles. This fraction is chromatographed on ECTEOLA cellulose column using a continuous gradient of ClNa for elution. The new radioactive and biologically active fraction is incubated with DNase or RNase. The RNase incubate alone is still biologically active. Then, the biological factor induced by a disturbed rate of pterines-growth hormones is really DNA. (Auth.)

304 L'Helias, C. INDUCTION DE DESORDRES TISSULAIRES CHEZ LES INSECTES PAR ALTERATION DE L'EQUILIBRE FACTEURS DE CROISSANCE PTERINIQUES/HORMONES DE CROISSANCE ET MECANISME DE CETTE INDUCTION. (Induction of tissue disorders in insects by altering the equilibrium between pterinic growth factors and growth hormones, and the mechanism of this induction.) C. r. Séanc. Soc. Biol. 160, 3 (1966) 461-465.

Injection of folic acid into chrysalids in diapause modified the pterine/growth hormone equilibrium and caused tissue disorganization. A factor isolated from the injected insects by prolonged centrifugation at 26 000 g was interspecific and produced tissue hyperplasia, increased the number of blood cells, produced testicular or intestinal melanomas, reduced the number of males, and caused larval death when injected into Drosophila. Injection of folic acid or 2-amino-4-hydroxypteridine carboxylic acid into female Carausius morosus did not alter these females, but increased the intersexuality of their descendents and caused death of the adult male offspring. Injection of the factor into aphids similarly did not affect the injected insects, but only affected the 3rd generation, producing a cuticular hardening in males. Crossing experiments indicated the involvement of cytoplasmic inheritance in transmitting the factor from treated Drosophila females. The isolation of the factor by homogenization of treated larvae, centrifugation, sucrose density gradient, and chromotography on ECTEOLA-cellulose is described; since the biologically active fraction coincides with that incorporating ^{3}H-thymidine and since DNase, but not RNase, abolished biological activity, the factor is apparently DNA. (CA 65: 1966, 19049d)

305 Lara, F.J.S. THE CONTROL OF NUCLEIC ACID SYNTHESIS IN THE SALIVARY GLANDS OF Rhynchosciara angelae. Final report Aug. 1965 - Jul. 1966. AD-640929, Sao Paulo Univ. (Brazil). Biochemistry Lab. 1966, 27p.

Methods were developed for extraction of RNA from salivary glands of Rhynchosciara, yielding high quality preparation as judged by hydrodynamic properties. By this method and pulse labelling the synthesis of RNA in the glands throughout larval development was studied. The principal class of RNA synthesised before the appearance of the large puffs is a 35 S RNA. This RNA is subsequently transformed into ribosomal RNA. After appearance of the large puffs one observes almost complete inhibition of synthesis of ribosomal precursor. This correlation indicates the material produced in puffs is important in control of synthesis of RNA. (Auth.)

306 Lara, F.J.S., Hollander, F.M. CHANGES IN RNA METABOLISM DURING THE DEVELOPMENT OF Rhynchosciara angelae. Natn. Cancer Inst. Monogr. No.27 (1966) 235-242. Published 1967.

A study was made of the nucleic acids (I) produced at the puffs in the giant polytene chromosomes of the salivary glands of R. angelae during developmental stage 3 and early and late stage 5 (prepupa), corresponding, respectively, to times before, during, and after the appearance of the giant chromosomal puffs. I were isolated in bulk and assessments were made of possible correlations between alterations of their biological, chemical, and physicochemical properties and the appearance of the puffs. The levels of DNA and RNA determined throughout the larval development appeared to attain max. corresponding to definite periods (late stage 4 and early stage 5) and coinciding in time with the appearance of many large puffs in the chromosomes. Prior to the appearance of large puffs, I labelling in larvae sacrificed 40 min after the injection of uridine-^{3}H took place in an RNA having a sedimentation constant of approx. 35 S; incorporation also took place in other places, with peaks being observed at 18 and 4 S. The specific activity of the 18 S RNA was about twice that observed in the 28 S RNA. The rapidly labelled 35 S material matured into RNA having the sedimentation characteristics of ribosomal RNA. Incorporation of ^{3}H during 80 min led to the labelling of all classes of RNA present in the sedimentation profile, as well as of the 35 S RNA. Results differed in larvae of the age at which the giant

puffs were present in the salivary chromosomes, the specific activities being generally lower than those observed at the earlier developmental stage, not much difference being observed between incorporation during 40 and 80 min. Practically no incorporation of ^3H was observed in larvae at the end of the 5th developmental stage, when the giant puffs had regressed, indicating that the inhibitory processes, already apparent at the stage where puffs were present, reached their max. intensity at this age. It could not be decided whether the observed inhibition was at the level of synthesis or resulted from a rapid destruction of the rapidly labelled RNA by degradative enzymes which might increase in late larval life, but it could be shown that such degradative enzymes were not operative during the RNA extraction process. Since no particularly distinct class of molecules sedimenting at 28 S was observed in the 40-min incorporation experiments, whereas the 18 S class was always very distinct and had a specific activity higher than that observed in the 28 S region, it appeared that the processes leading to the formation of two classes of ribosomal RNA had different velocities, as had been reported for rat liver, HeLa cells, and bacteria. It was suggested that the control of RNA synthesis might depend on the concentration of amino acids available to the cells, as had been found with bacteria. The findings indicated a correlation in the occurrence of important molecular events in the cells and of morphological alterations in the chromosomes. (CA 68: 1968, 66864 v)

307 Leach, W.M. FORMATION OF TRITIUM POOLS DURING MITOSIS. J. Cell Biol. 23, 2 (1964) 52A-53A. Abstr. 104. "4th Annual Meeting of the American Society for Cell Biology. Cleveland, Ohio, USA, 11-13 Nov. 1964".

Synthesis of DNA in grasshopper neuroblasts, determined by incorporation of ^3H-labelled thymidine (^3HTdR) into acid-insoluble DNase-digestible material, extends from middle telophase to very early prophase. To test the possibility that ^3H derivatives accumulate in stages of the cell cycle during which DNA synthesis does not occur, neuroblasts in different stages between early prophase and early telophase were exposed to ^3HTdR and "mapped" for subsequent reidentification, then rinsed in culture medium which contained excess unlabelled thymidine. Mitotic progress of mapped cells was observed by bright-field microscopy. Mapped cells were fixed 10 - 15 min after the start of DNA synthesis and reidentified in autoradiograms. Incorporation of ^3H into DNA was less in neuroblasts exposed to ^3HTdR during prometaphase and metaphase than in those exposed in early, middle, and late prophase, or early telophase. Ranges of grain numbers were similar for neuroblasts rinsed in excess unlabelled thymidine for 5 or 20 min after exposure to ^3HTdR during metaphase. A possible interpretation of these observations is that intracellular retention of a "pool" of ^3H derivatives is dependent on the presence of the nuclear membrane.

308 Leach, W.M., Carlson, J.G. ULTRAVIOLET-INDUCED INCORPORATION OF TRITIATED THYMIDINE INTO Chortophaga NEUROBLASTS DURING PROPHASE. J. Cell Biol. 35, 2, Pt.2 (1967) 77A. Abstr. 157. "7th Annual Meeting of the American Society for Cell Biology. Denver, Colo., USA. 13-15 Nov. 1967".

Synthesis of deoxyribonucleic acid in neuroblasts of the grasshopper C. viridifasciata (De Geer) has been determined by radioautography to end during very early prophase. Middle and late prophase neuroblasts, however, incorporate ^3H-thymidine (^3H-TdR) into acid-insoluble deoxyribonuclease-digestible material, as detected by radioautography. At the 2804-Å wavelength, middle prophase neuroblasts incorporated ^3H-TdR after 256 erg/mm^2, an exposure level at which mitotic delay is not detected. Incorporation is detected after 512 erg/mm^2 at each of the wavelengths examined: 2483, 2537, 2650, 2804, and 2967 Å; but the wavelengths are not equally effective. As the cell progresses through middle prophase, the most effective wavelength in inducing ^3H-TdR incorporation shifts from 2537 Å at the beginning of middle prophase to 2804 Å during the terminal part of middle prophase. During late prophase, however, a similar shift in effective wavelengths is not observed. (Abstr.)

309 Lezzi, M. RNS- UND PROTEIN-SYNTHESE IN PUFFS ISOLIERTER SPEICHELDRÜSEN-CHROMOSOMEN VON Chironomus. (RNA and protein synthesis in puffs of isolated salivery gland chromosomes of Chironomus.) Chromosoma 21, 1 (1967) 72-88. (In German, with English abstract)

Isolated salivary gland chromosomes of C. tentans incubated in a simple salt or sucrose solution are able to synthesise not only RNA but also protein in their puffs. Two different methods were used to expose the chromosomes to the radioactive medium which contained ^3H-cytidine-5'-triphosphate (^3H-CTP) or L-amino acids uniformly labelled with ^{14}C. ^3H-CTP was primarily incorporated into puff RNA, particularly in the Balbiani rings. The migration of radioactively labelled material from

isolated nucleoli to isolated chromosomes suggests that not all protein in the puffs is synthesised by the puffs themselves but that part of the puff protein stems from the nucleoli. It is concluded that besides bound RNA polymerase a puff contains ribosomes attached to the growing mRNA molecules.

310 Lima-de-Faria, A., Moses, M.J. ULTRASTRUCTURE AND CYTOCHEMISTRY OF METABOLIC DNA IN Tipula. J. Cell Biol. 30, 1 (1966) 177-192.

A DNA body is present in the females of the fly T. oleracea and is formed in contact with the sex chromosomes in the oogonial interphases. At each oogonial mitosis, the DNA body follows the chromosomes to one anaphase group and is included in one of the telophase nuclei. The body increases appreciably in size during the interphase of meiosis. All oocytes have the body, but only a few nurse cells possess it. The DNA body synthesises its DNA at a different time from the chromosomes, as is shown by incorporation of tritiated thymidine, and contains 59% of the DNA of the nucleus, as is disclosed by spectrophotometric measurements. At late diplotene the DNA body disintegrates, releasing its DNA into either the nucleus or the cytoplasm. When studied in the electron microscope, the DNA body appears composed of a tight mass of intertwined fibrils. Demonstration that the main mass of the body is composed of DNA is obtained from cytochemical tests which reveal that the DNA body is Feulgen positive, stains green with azure B, incorporates ^{3}H-thymidine, and after digestion with DNase is Feulgen negative. The DNA of the body is complexed with histone, like the DNA of the chromosomes, as is revealed by an intense alkaline fast green staining. Electron microscope examination of oocytes reveals that one side of the DNA body is in close contact with the nuclear envelope and that the other side possesses an outer shell composed mainly of particles 150 - 250 Å in diameter. Between the outer shell and the chromosomes there is a band of low electron opacity, 4000 - 7000 Å thick. In the light microscope, this light band together with the outer shell is Feulgen negative and stains violet with azure B; this is confirmation of the presence of RNA. In the oocytes the nucleoli are found inside the DNA body. These nucleoli have a nucleolonema composed mainly of particles 150 - 250 Å. The nucleoli are Feulgen negative, alkaline fast green negative, stain violet with azure B, and do not stain with azure B after RNase digestion, thus confirming their RNA content. The presence of the nucleoli inside the DNA body and of a band of RNA between the body and the chromosomes is indicative of a high RNA synthetic activity. Since the DNA of the body is complexed with histone, as in the chromosomes, and the nucleoli are located inside the body, the simplest interpretation of the DNA body is that it represents hundreds of copies of the operons of the nucleolar organizing region or neighbouring regions. The situation found in Tipula has several basic features in common with the polytene chromosomes of other Diptera and with the hundreds of nucleoli present in Triturus oocytes. In all three cases, genes seem to be copied hundreds of times but are kept in different types of packages. A DNA body like the one in T. oleracea is found in other species of Diptera and in the Coleoptera. There is no indication, from the present investigation, that the DNA body is in any way associated with a virus. (Auth.)

311 Lockshin, R.A. INSECT EMBRYOGENESIS: MACROMOLECULAR SYNTHESES DURING EARLY DEVELOPMENT. Science, N.Y. 154 (1966) 775-776.

A new technique permits the injection of aqueous solutions into the eggs of certain Coleopteran insects (Leptinotarsa decemlineata, Tenebrio molitor and Dermestes maculata). 0.001 or 0.01 μCi/ml of ^{3}H-thymidine, -uridine, -leucine, or -phenylalanine (1-10 ml of solutions containing 1 or 10 μCi/ml) were injected into eggs of Leptinotarsa and Dermestes. DNA and protein are synthesised from the onset of development, but the synthesis of RNA is not detectable until the migrating cleavage nuclei arrive at the cortex of the egg.

312 Mattingly, E., Whitfield, V.B. VARIATIONS IN METABOLIC ACTIVITY DURING THE LARVAL DEVELOPMENT OF Rhynchosciara. p. 50 of "Biology Division Semiannual Progress Report for Period Ending July 31,1966". ORNL-3999, Oak Ridge National Lab., Tenn. 1966, 217p.

DNA synthesis in the salivary gland remains extremely vigorous throughout early development. Other tissues with polytene chromosomes (gastric caeca, intestine, Malpighian tubules) show progressive diminution of DNA synthesis. Cells that are most active in synthesising DNA also show the highest degree of incorporation of ^{3}H-uridine and -leucine. The label resulting from the incorporation of amino acid is associated most strongly with the DNA-positive bands of the chromosomes. After several hours' exposure to the isotope the puffs become heavily labelled.

313 Mattingly, E.M. VARIATIONS IN METABOLIC ACTIVITY DURING THE LARVAL DEVELOPMENT OF Rhynchosciara. J. Cell Biol. 31, 2 (1966) 74A. Abstracts of Papers Presented at the "6th Annual Meeting of the American Society for Cell Biology, Houston, Tex., USA. 17-19 Nov. 1966". Abstr. 148.

The habit of synchronous development seen in the insect R. angelae and related species has been used for the study of metabolic events in relation to larval development and to chromosomal phenomena such as the formation of puffs. DNA synthesis in the salivary gland, as demonstrated by radioautography, remains extremely vigorous throughout early development. Other tissues with polytene chromosomes, such as gastric caeca, intestine, and Malpighian tubules, show progressive diminution of DNA synthesis, so that at the stage of formation of the previously described DNA puffs on the salivary gland chromosomes there is very little evidence of DNA synthesis in the other tissues. The cells that are most actively synthesising DNA also show the highest degree of incorporation of ^{3}H-uridine and ^{3}H-leucine. Particular attention has been given to the labelling of polytene chromosomes with ^{3}H-leucine at different stages of development. The label resulting from incorporation of the radioactive amino acid is associated most strongly with the DNA-positive bands of the chromosomes. After several hours' exposure to the isotope, the chromosome puffs also become heavily labelled. The most rapidly labelled nuclear components are the many micronucleoli associated with certain bands of the chromosomes. Fixation with neutral formalin shows that much of the label that is removed by acid fixation is concentrated in these micronucleoli. (Abstr.)

314 Morris, O.N. INCORPORATION OF RADIOACTIVE URIDINE INTO THE RNA OF THE LEPIDOPTERAN, Barathra brassicae. J. invertebrate Path. 8 (1966) 259-261.

The incorporation of uridine-^{3}H into RNA of the tissues of B. brassicae was followed by autoradiographic techniques. Autoradiographs were prepared 60 min to 24 h after interhaemocoelic injection. At 70 min, nuclear RNA was heavily labelled but cytoplasmic RNA only lightly. At 100 min all organs were heavily labelled but fat body relatively less than gut and other ectodermal tissues. Except in fat body and neurolemma, the amount of labelling appeared to decrease after 3 h. (CA 65: 1966, 9404 h)

315 Muckenthaler, F.A., Mahowald, A.P. DNA SYNTHESIS IN THE OOPLASM OF Drosophila melanogaster. J. Cell Biol. 28, 2 (1966) 199-208.

^{3}H-thymidine was injected into 2-d-old D. melanogaster females, and tissue sections were prepared from the ovary for radioautography with both the light and electron microscopes. Thymidine-^{3}H was incorporated into nuclei of nurse cells, follicle cells, and into ooplasmic DNA. The highest level of incorporation occurred at stage 12. The 15 nurse cell nuclei also incorporated thymidine at this stage even though they were degenerating. The label in the ooplasm was removed by extraction with DNase only if the extraction was preceded by a treatment with protease to remove the proteins from the sections. Electron microscopic radioautography revealed that 36% of the Ag grains resulting from decay of thymidine-^{3}H were found over mitochondria, 28% were located within 0.25 μ of these organelles, and 36% probably represented synthesis in the cytoplasm by the "storage DNA" characteristic of many eggs. It was suggested that one mechanism acting throughout the egg chamber is responsible for the synchronous synthesis of DNA in the degenerating nurse cells, in the mitochondria of the egg, and in the "storage DNA" of the ooplasm. (CA 64: 1966, 16342 de)

316 Muhammed, A., Gonçalves, J.M., Trosko, J.E. STUDY OF DNase AND DNA POLYMERASE ACTIVITY DURING Drosophila DEVELOPMENT. p.41-42 of "Biology Division Semiannual Progress Report for Period Ending January 31, 1966". ORNL-3922, Oak Ridge National Lab., Tenn. May 1966, 207p.

The study was undertaken to delineate the levels of some of the synthetic and degradative enzymes related to DNA during insect embryogenesis and histolysis-histogenesis. Sterile extracts of Drosophila were collected throughout the developmental cycle (fertilized egg to adult). DNA polymerase activity was determined by the incorporation of ^{3}H-ATP into an acid-insoluble DNA product. The pattern of DNase activity during development is shown graphically, but proved almost impossible to characterize since the DNases in the crude extract interfered with the assay. DNA polymerase activity in egg extracts indicates, however, that the enzyme could utilise either native or denatured DNA as a primer for DNA synthesis.

317 Muhammed, A., Gonçalves, J.M., Trosko, J.E. DEOXYRIBONUCLEASE AND DEOXYRIBONUCLEIC ACID POLYMERASE ACTIVITY DURING Drosophila DEVELOPMENT. Devl Biol. 15 (1967) 23-32.

Relative DNase activity has been found to increase in extracts of different developmental stages of Drosophila in the following manner: eggs, 2-d-old pupae, 1-d-old pupae, adults, and 3-, 5- and 7-d-old larvae. Some of the activity might be of the endonuclease type. DNA polymerase activity was measured in the egg, but not in extracts of other development stages due to interference from DNases. Incorporation assays for DNA polymerase (replicative deoxyribonucleotidyl-transferase) contained the deoxyribonucleoside triphosphates of adenine, guanine, cytosine, and thymine, one of which was labelled with ^{3}H (dATP); calf thymus DNA (native or heat-denatured); Mg^{++}; extract; and Tris buffer (pH 7.0). A blank without DNA was used as a control of the incorporation of ^{3}H-dATP. The DNA polymerase seems to utilize either native or denatured DNA as primer.

318 Mukherjee, A.B. A COMPARATIVE STUDY OF THE KARYOTYPES AND PATTERN OF DNA SYNTHESIS IN MOSQUITOES. Diss. Abstr. 27, 4 (1966) 1039-B-1040-B.

This study was undertaken in an attempt to obtain additional information pertaining to the cytogenetics of mosquitoes. Five genera and 30 species of mosquitoes were included in the study of the karyotypes, and four genera and five species were considered for the study of the pattern of DNA synthesis. Chromosome preparations were made from the brain tissues of field collected 4th-instar mosquito larvae (prepupae). The standard procedure of squash technique was followed in preparing this material. For the autoradiographic study ^{3}H-thymidine (sp. activity 3 000 mCi/mM) was used for labelling the newly synthesised DNA. Kodak NTB_3 nuclear track liquid emulsion was used for tracking the β-particles emitted by thymidine-^{3}H. 4th-instar mosquito larvae were exposed to thymidine-^{3}H in a range from 1 - 12 h. Cromosome preparations were made from brain cells using aceto-lacto-orcein stain. In the study of each species several slides were prepared by staining with Feulgen reaction until the heterochromatin and euchromatin were distinguishable. To identify the karyotypes, their morphology, the position of the centromere in the chromosomes, and the number and ratio of length of chromosomes $\frac{I}{II + III}$ were studied. For autoradiographic study, the density of the silver grains over heterochromatin and euchromatin, the percentage of labelled cells in different time periods of exposure to thymidine-^{3}H and late replicating arms in chromosome pairs of different genera and species were observed and compared. The following conclusions are based on the results of this study: (1) The diploid chromosome complement of all species studied is six (2n = 6). (2) The karyotypes of each of the five genera are distinct and readily recognizable. The karyotypes of the species within each genus are similar and are not easily recognizable. (3) Only in the genus Anopheles have sex chromosomes (X and Y type) been identified. This is also in agreement with the reports of previous investigators. (4) Pairing of chromosomes at least in some stages of mitosis is a characteristic phenomenon of all the species studied. (5) Polyploid cells were found in one specimen of Culiseta impatiens (Walker), and chromosomes with abnormal arm lengths were found in the homologous pairs of another specimen of the same species. (6) A satellite, which is a pinched off portion of a chromosome in the distal region of an arm which remains attached to the main body by a tenous thread of chromatin, was found with the chromosome pair II in Psorophora signipennis (Coquillett). (7) The pattern of DNA synthesis, as revealed from the amount of labelling of the interphase nuclei, the silver grain density over euchromatin and heterochromatin, and the percentages of labelled interphase nuclei, is very distinct in the different genera and species of mosquitoes investigated in the present study. (8) A heterochromatic mass was found in the Feulgen stained preparations of all species investigated, and these heterochromatic regions were found to synthesise their DNA at a different time than the euchromatin. (9) A late replicating region was found in one pair of chromosomes in each species. In Aedes dorsalis (Meigen), A. cataphylla Dyar, and Culiseta inornata (Williston) the late replicating region is found in the chromosome pair III. In P. signipennis this is present in chromosome pair II which is the satellited pair of chromosomes, and in Culex tarsalis Coquillett one arm of the chromosome pair I replicated later than the other arm. (10) As a result of this study it is concluded that although mosquitoes are very similar from the standpoint of chromosome number, they show many distinctive features in their karyotypes and DNA synthetic pattern. (11) White's hypothesis (1949) of the evolution of the mosquito karyotype, other than in the genus Anopheles, from the tipuloid type of Diptera by incorporation of sex chromosomes with the autosomes is supported by the results of this study. (From DA)

319 Nigon, V., Legay, J.M., Nonnenmacher, I. L'INCORPORATION DE THYMIDINE TRITIEE DANS LES GLANDES SERICIGENES DE Bombyx mori. Bull. biol. Fr. Belg. 95 (1961) 128-133.

De la thymidine tritiée a été injectée à des chenilles de Bombyx mori au 5e âge. Les glandes séricigènes ont été prélevées de 15 minutes à 5 jours après l'injection et l'incorporation de la thymidine a été étudiée par autoradiographie. La thymidine paraît se fixer exclusivement dans l'ADN. Le maximum d'incorporation est observé environ une heure après l'injection. Après 5 jours, on constate une dilution très forte qui pourrait indiquer l'existence d'une perte d'ADN marqué. La fixation de la thymidine se fait principalement dans le tube sécréteur, à l'exclusion des autres parties de la glande. On peut mettre ces différences en parallèle avec l'activité différente, qualitativement et quantitativement, des deux régions considérées. Dans certains noyaux, le marquage ne se produit que sur une partie du territoire nucléaire, attestant l'existence d'un asynchronisme fonctionnel entre les diverses régions d'un même noyau. La permanence de cette hétérogénéité conduit à diverses hypothèses au sujet de la structure nucléaire. (Aut.)

320 Oak Ridge National Lab., Tenn. CYTOLOGY AND GENETICS. p. 41-42 of "Biology Division Semiannual Progress Report for Period Ending January 31,1966". ORNL-3922. May 1966, 207p.

DNA polymerase activity was determined by means of ^{3}H-ATP incorporation. The enzyme could utilize either native or denatured DNA as a primer for DNA synthesis. Work was also carried out on Drosophila.

321 Oberlander, H. Schneiderman, H.A. JUVENILE HORMONE AND RNA SYNTHESIS IN PUPAL TISSUES OF SATURNIID MOTHS. J. Insect Physiol. 12 (1966) 37-41.

Pupae and developing adults received injections of ^{3}H-uridine (10 µCi/g, 0.37 Ci/mM). (RNase digestion was used in controls and removed>70% of the label). It was found that when intact pupae of saturniid moths developed into "2nd pupae" under the influence of a juvenile hormone extract, their fat body, blood cells, and tracheal epithelium synthesised RNA at a higher rate than during normal development. In contrast, juvenile hormone extract had no effect on the rate of RNA synthesis of tissues of isolated pupal abdomens which lack prothoracic glands. It is suggested that juvenile hormone extract has no direct metabolic effects on any pupal tissues in saturniid moths except for the prothoracic glands.

322 Orlando, E. THYMIDINE H^{3} INCORPORATION IN THE NURSE CELLS OF AMPHIGONIC AND PARTHENOGENETIC OVARIES OF Megoura viciae (HOM. APH.). Experientia 22, 10 (1966) 686-687. (In English, with Italian summary)

Both amphigonic and parthenogenetic female individuals are present in aphids, the former carrying ovaries with large polyploid nurse cells while the latter are viviparous and carry ovaries with very small, usually diploid nurse cells. Amphigonic and parthenogenetic females of M. viciae at various stages of development were injected in the abdomen with 0.1 µCi of ^{3}H-thymidine. The animals were fixed and embedded at intervals of from 1 h to 4 d. In the amphigonic female an active nuclear incorporation of ^{3}H-thymidine occurs during growth. However, even when the nurse cells are functioning fully, and when the nuclei appear to have achieved max. development, incorporation continues, without affecting all the nuclei. Results indicate that the active synthesis occurring in the nuclei concerns metabolic but not genetically stable DNA. Metabolic DNA may be synthesised in the nurse cells of amphigonic insects.

323 Pavan, C., Basile, R. CHROMOSOME CHANGES INDUCED BY INFECTIONS IN TISSUES OF Rhynchosciara angelae. Science, N.Y. 151 (1966) 1556-1558.

The main effects of two infections, one by a protozoan and the other by a virus, in cells of R. angelae (Diptera, Sciaridae) are an increase in cell size and changes in the size, shape, and behaviour of the chromosomes. The X-chromosome of some cells reacts differently from the autosome to the protozoan infection. In cells heavily infected with the protozoan (presumably a microsporidian), the surface of the chromosomes frequently had a coat of RNA, which showed massive incorporation of ^{3}H-uridine from 20-40 min after injection of the larva. Some chromosomes show specific, easily traceable points after infection by the virus. Some of the effects of these infections may be similar to the effects of infective agents in other organisms.

324 Pelling, C. A REPLICATIVE AND SYNTHETIC CHROMOSOMAL UNIT: THE MODERN CONCEPT OF THE CHROMOMERE. Proc. R. Soc., Ser. B 164 (1966) 279-289.

New approaches to studying the chromomere organization of the chromosome have recently been made by the combined use of cytological, autoradiographic, and photometric methods. The evidence thus obtained is reviewed. Giant Dipteran chromosomes (e.g. Chironomus tentans, thummi thummi, th. piger) permit a study of the topography of DNA replication in great detail. Each chromomere appears to replicate its DNA independently of other chromomeres. Autoradiographic studies suggest a correlation between the length of the replication period of a chromomere and the amount of DNA present in it. The chromomere may be regarded as an essential part of chromosome structure, characterized by its own DNA synthesis. Microspectrophotometric findings together with autoradiographic results point to the chromomere as a molecular unit of replication. A study of the puffing phenomenon reveals, moreover, that the gradual loosening of the chromosomal material, mainly DNA, tightly packed within the band, goes hand in hand with a gradual increase of the RNA production of that band. The regulation of RNA synthesis at the chromomere level is discussed. The functional significance of the chromomere is linked with the specificity of the unfolding mechanism, which affects each chromomere independently. It is not possible yet to clearly separate the mechanisms involved in the unfolding of the chromomeric DNA from the factors which guarantee that these mechanisms start their work and always act at defined places.

325 Pettit, B.J., Rasch, R.W., Rasch, E.M. DNA SYNTHESIS IN THE GIANT SALIVARY CHROMOSOMES OF Drosophila virilis PRIOR TO PUPATION. J. Cell Physiol. 69, 3 (1967) 273-279.

There was no consistent increase in DNA in late larval or prepupal stages. Three classes of DNA amounts from the salivary gland were compared with the DNA amounts from haemocyte nuclei of the same larva. The salivary gland nuclei were geometric mutiples of the haemocyte DNA amounts. Female prepupa had a larger amount of nuclei in higher polytene classes than in the male of the same age. The percentage of salivary nuclei incorporation of thymidine-^{3}H (I) markedly decreased shortly after spiracle pigmentation in both sexes. Female larvae had slightly increased I incorporations ~4 h after pigmentation. I was incorporated into chromosomes with a continuous or discontinuous type of pattern. All labelled nuclei were labelled to the same extent in the heterochromatin. (CA 67:1967, 88659 p)

326 Platova, T.P. THE ROLE OF NURSE CELL NUCLEI IN THE FORMATION OF OOCYTE CYTOPLASMIC DNA IN Drosophila. Tsitologiya 9, 7 (1967) 834-839.

Females of D. virilis, 5 d old, were treated with thymidine-^{3}H (specific activity 4.4 Ci/mM, 0.2 µl/animal) at 10 or 22°C. Incorporation of the labelled material was studied autoradiographically in thin slices of ovarian tissue. At the period of yolk formation when reduplication of DNA took place in nurse cell nuclei (stage 9 - 10 of the oocyte development), quick incorporation of thymidine-^{3}H proceeded in nuclei of these cells that was observable 5 min after the application of the labelled material (at 22°C). Incorporation of thymidine-^{3}H in cytoplasm was found at least 20 min after the injection. At 10°C, a pronounced retardation of thymidine incorporation in cytoplasm was observed: as late as 2 h after thymidine injection the ooplasm was labelled slightly, if at all; the nurse cell nuclei were labelled intensively. Nurse cell nuclei took part in the ooplasmic DNA formation. A part of cytoplasmic DNA was synthesised in cell nuclei and passed into the ripening oocyte. (CA 67 : 1967, 106357 v)

327 Plaut, W., Nash, D., Fanning, T. ORDERED REPLICATION OF DNA IN POLYTENE CHROMOSOMES OF Drosophila melanogaster. J. molec. Biol. 16, 1 (1966) 85-93.

Sites of DNA synthesis on the polytene chromosomes of Drosophila can be identified autoradiographically after incubating excised salivary glands for 10-15 min in a medium containing ^{3}H-thymidine. Using this technique the patterns of DNA synthesis have been mapped relative to the cytologic banding pattern and the frequency measured with which specific chromosome regions appear labelled in a population of nuclei. This frequency is found to be a specific function of the region, reinforcing the previous suggestion that the chromosome contains a longitudinal array of DNA replicative units. Following Jacob and Brenner (1963), these units were denoted as 'replicons'. The precision with which any single replicon can be localized is limited by autoradiographic resolvability as well as the necessity for its temporal differential replicative activity relative to its neighbours. At least 30 replicons have been identified in the less than 15% of the cumulative lengths of the D. melanogaster chromosomes studied. While the identification of a replicon requires spatial discreteness and differential behaviour, and thus implies a degree of independence, its autonomy is demonstrably incomplete. The data fit most simply the notion that all replicons are active together at some time in the overall replicative cycle, but that some remain active over longer periods than others. (Auth.)

328 Pollister, A.W., Arnold, G. AN AUTORADIOGRAPHIC STUDY OF RNA SYNTHESIS IN NUCLEI OF ISOLATED SALIVARY GLANDS OF Drosophila hydei. J. Cell Biol. 23, 2 (1964) 75A. Abstr. 153. "4th Annual Meeting of the American Society for Cell Biology, Cleveland, Ohio, USA, 11-13 Nov. 1964".

Isolated salivary glands were incubated in a Ringer type solution containing cytidine-^{3}H or uridine-^{3}H for periods from 3 - 60 min. Autoradiographs were made on 4-μ sections of frozen-substituted glands. Relative RNA concentrations were estimated photometrically as azure B stain. Differences in relative amounts of incorporation of the two labelled precursors suggest the presence of two RNA fractions in the nucleolus: (a) characterized by a high proportion of uridine, and (b) with less uridine and a longer association with the nucleolus. Specific turnover rates of RNA in nucleolus and chromatin appear to be approximately equal, as found by previous workers in various materials. Determinations of dry weight concentrations were made by interferometry, in order to apply a correction for self absorption, as given by Maurer and Primbsch (Exp. Cell Research, 33; 1964, 8). The concentrations (mg/cm^2) were as follows (4-μ sections): nucleolus, 0.240; cytoplasm, 0.192; chromatin, 0.108 (means of 55 cells on 3 glands). These values lead to the following correction factors: nucleolus, × 11; cytoplasm, × 8.8; chromatin, × 5.0. Grain counts corrected by these factors show the specific nucleolar rate of turnover to be approx. 2.50 times that of the chromatin for uridine and approx. 4.25 times that of chromatin for cytidine. (Abstr.)

329 Prudhomme, J.C., Gillot, S., Daillie, J. EFFETS DE L'ACTINOMYCINE D SUR LA SYNTHESE DE L'ADN ET DE L'ARN DANS LA GLANDE SERICIGENE DE Bombyx mori L. Expl Cell Res. 48, 1 (1967) 186-189.

Les auteurs ont employé thymidine-méthyl-^{3}H (6.5 et 8.5 Ci/mM) et uridine-5-^{3}H (18 Ci/mM). Même à la plus forte dose d'antibiotique, la phosphorylation de la thymidine n'est pas réduite de manière significative. L'arrêt de la synthèse de L'ADN, en présence de l'antibiotique, ne peut être attribué à un défaut de phosphorylation de la thymidine. Il semble probable que l'actinomycine D qui se fixe sur l'ADN empêche ainsi sa réplication. On peut définir la concentration d'actinomycine susceptible de déterminer la réduction de la synthèse d'ARN à 50% de sa valeur (DI 50 ARN) et sur le même matériel le paramètre correspondant pour ce qui concerne la synthèse d'ADN (DI 50 ADN). Les résultats donnent un rapport Δ= DI 50 ADN/DI 50 ARN = 51.

330 Przelecka, A. NUCLEIC ACID METABOLISM AND CELL INTERACTION IN THE OVARIOLE OF Galleria mellonella. Folia Histochem. Cytochem. 4, 3 (1966) 223-236.

Nucleic acid metabolism was studied in the ovariole of a lepidopteran, G. mellonella. In the cells composing the follicular vesicle, differences in localization of RNA during vesicle differentiation were visible. Isotope experiments showed that nuclei of the trophic cells were sites of intense synthesis of RNA. In young vesicles the oocyte nucleus was equally active in the synthesis of RNA, while at a later stage a remarkable preponderance of the polyploidal trophocyte nuclei in this process was observable. The synthesis of RNA in the follicular epithelium was highest after the autolysis of trophocytes. The structural disintegration of trophocyte nuclei was accompanied by loss of their synthetic activity. Both the cytochemical staining and the results of isotope experiments showed migration of RNA from the trophocyte chamber into the oocyte. The activity of glucose-6 phosphate dehydrogenase indicating the cell ability for the synthesis of nucleosides, was either localized in basophilic regions of the oocyte or extended in the direction of the contiguous cytoplasm of the neighbouring cells. It is suggested that physiologic contact between the oocyte and the trophocyte cells may have a reciprocal character. The endoplasmic reticulum appeared to be a structure that makes contact possible between the oocyte and the trophocyte chamber. (Nuclear Medicine)

331 Rasch, E.M., Pettit, B.J. NUCLEOPROTEIN METABOLISM IN SALIVARY GLAND CHROMOSOMES OF Sciara DURING PUPATION. J. Cell Biol. 35, 2, Pt.2 (1967) 110A-111A. Abstr. 228. "7th Annual Meeting of the American Society for Cell Biology. Denver, Colo., USA. 13-15 Nov. 1967".

Differences in relative rates of nucleic acid and protein synthesis during periods of maximal puffing activity by the giant salivary chromosomes of S. coprophila were studied by radioautography. Pairs of glands from carefully staged female larvae were pulse labelled by incubation for 15, 30, or 60 min in insect saline enriched with 25 μCi/ml of tritiated precursors. Heavy, differential labelling by DNA puffs and maximal labelling above non-puffing chromosomal regions occurred with ^{3}H-thymidine in mid 4th instar, followed by a sharp drop in percentage of labelled nuclei in glands from prepupae

and virtual cessation of DNA synthesis all along the chromosome by the time of pupal moult and throughout the period preceding gland lysis in 72-h-old pupae. During these stages, salivary chromosomes continued synthesis of RNA, showing maximal incorporation of ^{3}H-uridine or ^{3}H-cytidine about 72 h before pupation, and again just before pupal moult. Vigorous incorporation of ^{3}H-proline or ^{3}H-histidine was found in both the nucleus and the cytoplasm throughout 4th larval instar, with moderate labelling of chromosomes occurring in glands from prepupae and 24- or 48- h-old pupae. With ^{3}H-arginine, ^{3}H-lysine, or ^{3}H-tyrosine there were no clearly marked cyclic fluctuations in percentage of labelled nuclei or in distinctive labelling patterns of specific chromosome regions to mark formation of DNA puffs. By feeding larvae with ^{3}H-thymidine at mid 4th instar and then sacrificing at subsequent stages of prepupal or pupal development, fate of the extra DNA synthesised at specific puff sites of chromosome 2 was followed over an 8-d-period of growth on unlabelled medium. Grain counts showed no significant diminution of labelling above DNA puffs, nor was there displacement of label to suggest dispersion of DNA from these chromosomal sites to other cellular organelle systems. The DNA produced by heterochromatic puff loci thus shows metabolic stability as expected for genetic or template DNA. (Abstr.)

332 Reddy, S.R.R., Wyatt, G.R. INCORPORATION OF URIDINE AND LEUCINE IN VITRO BY Cecropia SILKMOTH WING EPIDERMIS DURING DIAPAUSE AND DEVELOPMENT. J. Insect Physiol. 13, 7 (1967) 981-994.

A preparation consisting of fragments of wing epidermis from pupae of the silkmoth, Hyalophora cecropia, has been incubated in a synthetic medium, and the effects of some conditions on incorporation of 2-^{14}C-uridine and ^{3}H-leucine into RNA and protein, respectively, have been studied. Under standard conditions, the rates of incorporation remained unchanged when the precursors were added to tissue that had been preincubated for different times up to 20 h. Tissue from insects commencing adult development after diapause, through the action of either endogenous or injected ecdysone, showed increased biosynthetic rates. Stimulation was evident 10 h after injection of the hormone. Quantitatively, however, increases were less than those found when incorporation was measured in vivo. No effect was detected of pure ecdysone added in vitro to tissue from diapause pupae, which suggests that the tissue had lost sensitivity to the hormone. (Auth.)

333 Ritossa, F. A NEW PUFFING PATTERN INDUCED BY TEMPERATURE SHOCK AND DNP IN Drosophila. Experientia 18, 12 (1962) 571-573.

The same effects on the puffing pattern are obtained whether temperature shocks are given to the whole larvae or to salivary glands extracted and incubated in Ringer solution. The induced structural modifications can be shown to correspond to actual changes in the synthetic activity of the chromosome bands concerned. ^{3}H-cytidine was administered to salivary glands incubated in vitro and heated. The presence of rather large quantities of tracer in the puffs was apparent already after 3-4 min and reached high values after 10 min. Radioactivity was removed by RNase. This proves that as previously shown for normal spontaneous puffs, a rather high rate of RNA synthesis occurred also in temperature-induced puffs (2L 14, 2L 15, 2L 20).

334 Ritossa, F.M., Pulitzer, J.F. ASPECTS OF STRUCTURE OF POLYTENE CHROMOSOME PUFFS OF Drosophila busckii DERIVED FROM EXPERIMENTS WITH ANTIBIOTICS. J. Cell Biol. 19, 2 (1963) 60A. Abstr. 143.

By autoradiographic methods it can be shown that DNA is present all along the structure of a puff. Since puff formation does not require new DNA synthesis, this DNA is apparently the same as that of the bands from which the puffs originate. Preferential amino acid incorporation (leucine, tryptophan, and lysine) at the puff level is not found either when the puff is functioning or when the puff is forming. This suggests that enhanced protein turnover does not occur in the puff and that new protein synthesis is not necessary for puff appearance. The latter conclusion is also supported by experiments utilising puromycin. Although puromycin inhibits amino acid incorporation into protein in salivary gland cells, it does not inhibit puff formation. On the other hand, RNA synthesis appears to be specifically related to puff structure in the sense that an intense RNA synthesis is found in puffs. Actinomycin C and actinomycin D completely block RNA synthesis in the salivary gland cells without apparent interference with protein synthesis. Also actinomycin C and D completely inhibit puff formation. This indicates that the only synthesis required for a puff to appear is that of RNA. (From abstr.)

335 Ritossa, F.M., Atwood, K.C., Spiegelman, S. ON THE REDUNDANCY OF DNA COMPLEMENTARY TO AMINO ACID TRANSFER RNA AND ITS ABSENCE FROM THE NUCLEOLAR ORGANIZER REGION OF Drosophila melanogaster. Genetics 54 (1966) 663-676.

Experiments are described which establish that approx. 0.015% of the DNA of D. melanogaster is complementary to the amino acid transfer RNA (t-RNA). This number leads to about a 13-fold redundancy for each of the approx. 60 t-RNA species. Hybridizations with DNA from stocks carrying one, two, three, and four doses of the nucleolus organizer region established that the t-DNA cannot be detected in the region of the genome which has been shown to contain the complete cluster of DNA complementary to the two ribosomal RNA components. For isotopic labelling the standard medium of Ritossa and Spiegelman was modified to contain 0.5 g of yeast/10 ml. To each 10 ml were added either 7 mCi of ^{3}H-uridine (21 Ci/mM) or 5-10 mCi of ^{32}P after hydrolysis to remove pyrophosphate, and neutralization. The usual RNA employed in these studies had a specific activity > 50 000 cpm/μg. Details are given of the procedures used for extracting and purifying RNA, preparing DNA, and for determining the base composition of RNA.

336 Ritossa, F.M., Atwood, K.C. UNEQUAL PROPORTIONS OF DNA COMPLEMENTARY TO RIBOSOMAL RNA IN MALES AND FEMALES OF Drosophila simulans. Proc. Natn. Acad. Sci. U.S.A. 56, 2 (1966) 496-499.

Drosophila DNA and RNA were labelled, isolated, and molecular hybridization procedures performed. In D. simulans the X-chromosome contained 8 times as much rDNA as the Y, and 1.5 times as much as either X or Y of D. melanogaster. The differences were correlated with the absence of a wild-type allele of bobbed on the D. simulans Y-chromosome. (CA 65: 1966, 20568 c)

337 Rodman, T.C. FACTORS INFLUENCING INITIATION OF POLYTENIC REPLICATION. J. Cell Biol. 35, 2, Pt.2 (1967) 115A-116A. Abstr. 240. "7th Annual Meeting of the American Society for Cell Biology. Denver, Colo., USA. 13-15 Nov. 1967".

Earlier work had indicated that initiation of the DNA synthesis of a polytenic replication cycle may take place as long as the larval state prevails, and the DNA synthesis occurring in the polytene nuclei of prepupae is that of propagation of the final cycle. That conclusion is supported by the present study, in which radioautographs interpreted as characteristic of the initial phase of the DNA synthetic cycle are obtained until shortly after formation of the white prepupa, then abruptly cease to be produced. On the other hand, thymidine incorporation in radioautograph patterns believed to represent the latter part of the cycle is observed throughout the larval and prepupal periods, suggesting that a condition essential for initiation of polytenic replication is not obligatory for propagation. This report includes a description of the bases for assigning the various radioautograph patterns produced in the nuclei of a salivary gland to an ordered sequence in the replication cycle, and an analysis of the distribution of those patterns at successive larval and prepupal stages. The data are compatible with two possible interpretations: (1) The information for a component of a milieu supporting initiation of polytenic replication is transcribed only in the larval state; (2) the information for an inhibitor of initiation is transcribed in the prepupal state. (From abstr.)

338 Roels, H. "METABOLIC" DNA: A CYTOCHEMICAL STUDY. Int. Rev. Cytol. 19 (1966) 1-34.

Review article drawing on examples taken from studies which include plants and insects. The review is divided into sections on cell growth and nuclear DNA (embryonic development, regeneration and compensatory hypertrophy, tumour growth); cell function and nuclear DNA (plant cell nucleus, giant chromosomes of insects, nutrient cells, liver cell nuclei, exocrine glands, endocrine glands, target organs of the sex hormones); sites of gene activity in the interphase nucleus (nucleolus-associated chromatin, heterochromatin). Insect data are cited on p. 13-14, 22-24, and 26.

339 Rudkin, G.T. NUCLEIC ACID METABOLISM IN GIANT CHROMOSOMES OF Drosophila melanogaster. Ann. Histochim., Suppl. 2 (1962) 77-84.

The total absorbancy of monochromatic u.v. radiation and the incorporation of ^{3}H-cytidine and -thymidine were measured in short sections of giant chromosomes of salivary glands at two stages in development, with and without treatment with RNase. The ratio of RNA: DNA was found to vary from region to region; the rate of incorporation of cytidine was not correlated with the amount of RNA or DNA present in a region. The rate of RNA synthesis was found to change very rapidly with

time in a single region; a high rate of synthesis was correlated with the process of swelling in the formation of a puff. — The tritiated compound was either injected into the full grown larva (500 µCi/ml, specific activity 360 mCi/mM or 1000 mCi/mM) or, in vitro, dissolved in a salt solution in which the salivary gland was placed (5 µCi/ml).

340 Sevastiyanova, G.A., Smolin, A.N. THE FREE NUCLEOTIDES AND THEIR DERIVATIVES IN INSECTS. Prog. mod. Biol. 61, 3 (1966) 321-337 (In Russian)

A review paper with 82 references. It deals with free nucleotides and nucleic acids in insects, free nucleotides and their derivatives as co-enzymes, and the luminescence of insects.

341 Simoes, L.C.G., Pavan, C. CHROMOSOME ACTIVITY IN THE SALIVARY GLAND OF Rhynchosciara MAINTAINED IN VITRO. p. 51 of "Biology Division Semiannual Progress Report for Period Ending July 31, 1966". ORNL-3999, Oak Ridge National Lab., Tenn. 1966, 217p.

Preliminary data suggest that in these chromosomes the synthesis of DNA starts independently in different bands, some of which are heterochromatic.

342 Sirlin, J.C.* Nature, Lond. 211 (1966) 1347.

" - reported labelling with ^{14}C-methionine of RNA components in Smittia larvae. He found that only the 4S peak of nucleolar RNA became labelled. This evidence, he suggested, supports the concept that the nucleolus synthesises 4S RNA which has a transfer-RNA function." (From a report by H. Busch on "The Cell Nucleus: Metabolism and Radiosensitivity", a meeting held at the Radiobiological Institute of the Organization for Health Research TNO in Rijswijk, Holland, May 9-11, 1966.)

* This author is presumably identical with J.L. Sirlin, the "C" being the result of a misprint.

343 Sirlin, J.L., Jacob, J., Birnstiel, M.L. SYNTHESIS OF DIFFERENT SPECIES OF NUCLEOLAR RIBONUCLEIC ACID. Biochim. biophys. Acta 108 (1965) 716-718.

The different species of RNA newly synthesised in the nucleolus of fully-grown larval salivary glands of Smittia parthenogenetica are described. Salivary glands were incubated in vitro, with appropriate radioactive precursors. The sucrose-gradient sedimentation profile of the RNA shows typically a pattern of radioactive peaks ranging from 4 to > 28 S, while the heights of the intermediate peaks differ somewhat with the experiment. In glands treated with DRB and TRB (5,6-dichloro- and 4,5,6,-trichloro-1-(β-D-ribofuranosyl)-benzimidazole, respectively), the radioactivity is largely confined to the 4-S and > 28-S peaks, the relative height of which is variable. These two molecular species of newly synthesised RNA are therefore nucleolar, and represent a true nucleolar synthesis.

344 Sirlin, J.L. SYNTHESIS OF 4 S RNA IN THE NUCLEOLUS OF Smittia. p. 87-96 of "International Symposium on the Cell Nucleus: Metabolism and Radiosensitivity. Rijswijk (Z.H.), The Netherlands, 9-12 May 1966". London, Taylor & Francis Ltd. 1966, 345p.

The synthesis of nucleolar RNA in the larval salivary glands of a chironomid was isolated within the intact gland by means of specific inhibition. Quantitative autoradiography of RNA synthesis was carried out using ^{3}H-uridine (91 µCi/ml), either with or without chlorine-substituted benzimidazoles (DRB and TRB) present throughout. In autoradiography of RNA methylation, glands were first incubated with puromycin, then with methionine (methyl-^{14}C) (50 µCi/ml) and puromycin. The picture of nucleolar synthesis proved to be identical with autoradiography of squashes or sections. Radioactive RNA extracted from glands in which nucleolar synthesis or methylation has been established autoradiographically is assignated to the nucleolus. Methylation of nucleolar RNA depends closely on synthesis. Parallel biochemical work indicates that part of the newly synthesised RNA is of high mol. weight, and part is of 4 S values with characteristics of transfer-RNA. Work on the latter RNA is discussed.

345 Sirlin, J.L., Jacob, J., Birnstiel, M.L. SYNTHESIS OF TRANSFER RNA IN THE NUCLEOLUS OF Smittia. Natn. Cancer Inst. Monogr. No.23 (1966) 255-266 (discussion 266-270 (?))

Larval salivary gland cells of the chironomid, S. parthenogenetica, were incubated with radioactive precursors of RNA. Sucrose gradient sedimentation patterns of newly synthesised RNA showed sRNA, ribosomal RNA, and RNA larger than 28S. That a high proportion of RNA synthesised in the larvae was in the nucleolus and that it was 4S RNA was concluded from several factors: (a) a high pro-

portion of RNA was synthesised when incubation was carried out in the presence of DRB and TRB (5,6-dichloro- and trichloro-1-β-D-ribofuranosylbenzimidazole, respectively), reagents which are known to allow only nucleolar synthesis; (b) when methylation was carried out, only 4S RNA was methylated and the nucleolus is known to be the predominant cell site of RNA methylation; (c) RNA synthesis was suppressed when actinomycin was used, and actinomycin suppresses nucleolus RNA synthesis. (CA 66:1967, 113432 g)

346 Spencer, J.B. NUCLEIC ACID AND PROTEIN SYNTHESIS IN SATURNIID PUPAE. Diss. Abstr. 27, 1 (1967) 40-B - 41-B.

In the present study the pattern of incorporation of ^{3}H-labelled uridine and thymidine into the nucleic acids of a number of tissues of the giant silkmoths Hyalophora cecropia and Samia cynthia was examined by autoradiographic procedures. The patterns of incorporation were recorded for diapausing pupae, injured diapausing pupae, and at different stages of adult development. Changes in the protein patterns were studied by electrophoretic separation of the blood serum at the same stages of the life cycle. Routine histological observations were also recorded for these animals. Autoradiographic analysis of DNA synthesis revealed that it occurs during adult development, but is suspended in all tissues except the blood cells and gonads during the diapause period. Injury which activates a number of biochemical systems held in abeyance during diapause, does not stimulate DNA synthesis in any tissues except the blood cells and those epidermal cells directly involved in the closure of the wound. Pulse-labelling experiments showed that resumption of DNA synthesis occurred in the wing epithelium at least 5 d before any visible morphological signs of development could be detected. Evidence which indicates that the resumption of DNA synthesis may be closely tied to ecdysone activation is discussed. It was shown that the synthesis of DNA does not resume synchronously in all tissues of the developing adult, but that each tissue resumes synthesis at a characteristic period. Not all tissues of the developing adult exhibit DNA synthesis, indicating that the hormonal environment at each moult may determine whether or not new DNA molecules are produced. The synthesis of RNA never seems to be suspended in any tissue examined, but injury and the onset of development cause an increase in the rate of RNA synthesis. Two distinct types of injury-stimulated response in the rate of RNA synthesis were detected. Incorporation patterns observed in tissues exposed to labelled uridine for periods longer than 2 h are consistent with present theories concerning the nuclear synthesis and subsequent transfer to the cytoplasm of RNA molecules. The incorporation of labelled uridine into the fat body tissues adjacent to the ovary was higher than for the fat body in other regions and this suggests that the ovary influences the metabolism of the surrounding fat body. The antibiotic actinomycin D when administered at the level of 0.5 μg/g reduced the rate of RNA synthesis in the tissues of injured diapausing pupae, but was not lethal. The synthesis of a blood protein elicited by injury was, however, inhibited by the administration of actinomycin concurrently with the injury. Inspection of the zymograms of blood proteins and examination of the incorporation of labelled amino acids into other proteins revealed that actinomycin at this concentration did not prevent the injury-stimulated increase in the amount of other proteins which are normal constituents of the blood of diapausing pupae. This differential action of actinomycin suggests that gene loci already employed as templates for the synthesis of messenger RNA are protected by this activity whereas nonfunctional loci are not. Preliminary experiments indicated that the blood cells are one source of the injury-elicited protein, and that this protein is a characteristic component of the blood of the developing adult. Crystalline inclusions in the Malpighian tubules and subepidermal glands of developing adults are described. Neither type of crystal was chemically characterized, but those in the Malpighian tubules exhibited label after the animal had been injected with either labelled thymidine or uridine. (From DA)

347 Swift, H. NUCLEIC ACIDS AND CELL MORPHOLOGY IN DIPTERAN SALIVARY GLANDS. p.73 of "The Molecular Control of Cellular Activity". Allen, J.M., Ed. New York, McGraw-Hill Book Company, 1962.

Review article. Work is cited on Drosophila, Sciara coprophila, Rhynchosciara, Chironomus, Glyptotendipes, grasshopper, etc. The DNA content of the chromosome, DNA and chromosome structure, proteins and chromosome structure, RNA-containing components, cytoplasmic protein synthesis, and implications of the work described are discussed. Radioisotopes were employed in numerous of the studies cited.

348 Takahashi, S. STUDIES ON RIBONUCLEIC ACID IN THE FAT BODY OF Philosamia cynthia ricini Donovan (LEPIDOPTERA) DURING DEVELOPMENT. J. Insect Physiol. 12 (1966) 789-801.

The fluctuation of RNA was determined using the fat body cells of P. cynthia ricini during the course of development from the 5th larval instar to the early pupal stage. The ratio of total RNA to DNA was high in the early 5th instar, but it decreased afterwards to reach a min. at pupation. This change was mainly accounted for by the reduction of RNA contained in the microsomal fraction. For the purpose of analysing further such changes in RNA, nucleic acids were isolated from the fat body cells by a slightly modified SDS-phenol method after injection of ^{32}P into the body cavity. The sRNA*, rRNA and DNA were fractionated by methylated serum albumin column chromatography. The ratio of sRNA to DNA was rather constant, while the ratio of rRNA to DNA decreased gradually during the progress of development. Incorporation of ^{32}P into sRNA and rRNA took place only in the early stage of the 5th instar. It is concluded that the RNA which exists in the fat body cells in the later stages of the 5th instar and pupal stage was synthesised during the first few days in the 5th larval instar. (Auth.)

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* sRNA – soluble (transfer) RNA.
rRNA – ribosomal RNA.

349 Thomas, K.K., Nation, J.L. RNA, PROTEIN, AND URIC ACID CONTENT OF BODY TISSUES OF Periplaneta americana (L.) AS INFLUENCED BY CORPORA ALLATA DURING OVARIAN DEVELOPMENT. Biol. Bull. 130 (1966) 442-449.

The concentrations of RNA and proteins were substantially lower in allatectomized females when compared with sham-operated females. Uric acid concentration remained approximately constant in allatectomized females, while in the controls it increased to more than double the concentration observed. The rate of incorporation of ^{3}H-labelled amino acids into the fat body of allatectomized females was slow compared to that of the sham-operated roaches. A very slow incorporation into ovarian tissue was observed in allatectomized females, as against a rapid rate of incorporation in controls. Midgut tissue exhibited a significantly greater incorporation of the isotope than that of sham-operated females. The probable relation between corpora allata and the synthesis of RNA, proteins, and uric acid during ovarian development is discussed. (From auth. summary)

350 Vermeulen, C.W., Atwood, K.C. THE PROPORTION OF DNA COMPLEMENTARY TO RIBOSOMAL RNA IN Drosophila melanogaster. Biochem. biophys. Res. Commun. 19 (1965) 221-226.

Molecular hybridization experiments have indicated that ~0.3% of the DNA in E. coli, B. megaterium, and Pisum sativum is reserved for the specification of ribosomal RNA. Evidence is presented that a similar proportion of the DNA in D. melanogaster can be hybridized with r-RNA. The methods are described for preparing DNA (from Oregon-R wild-type flies) and RNA (when flies were allowed to oviposit on corn meal-molasses medium containing 1 mCi/ml ^{3}H-uridine. Details are given. r-RNA-DNA hybridization was carried out under the conditions used by Yankofsky and Spiegelman (Proc. natn. Acad. Sci. U.S.A. 48: 1962, 1069). The DNA appears to be saturated when ~0.25% of its weight in RNA has been hybridized.

351 Watanabe, H. LOCALIZATION OF RIBONUCLEIC ACID SYNTHESIS IN THE MIDGUT CELLS INFECTED WITH CYTOPLASMIC POLYHEDROSIS VIRUS IN THE SILKWORM, Bombyx mori L. (LEPIDOPTERA: BOMBYCIDAE). Appl. Ent. Zool. 1, 3 (1966) 154-155.

An autoradiographic technique is described to locate the site of viral RNA synthesis within the midgut cells injected with cytoplasmic-polyhedrosis virus in the silkworm. Fourth-instar larvae of several strains were inoculated perorally with the virus. On the 2nd and 4th day after virus inoculation infected and control larvae were injected with 1 mCi/ml generally labelled ^{3}H-uridine; 5-h labelling periods were used. A significant difference was observed in the incorporation of RNA-precursor by healthy and virus-diseased cells. The nucleus appears to be the site of viral RNA synthesis in infected midgut cells. Since the virus particles and the polyhedra are only observable in the cytoplasm with the electron microscope, viral RNA produced in the nucleus is interpreted as being released into the cytoplasm in order to gain its coat of protein.

352 Watanabe, H. AUTORADIOGRAPHIC STUDIES ON THE NUCLEIC-ACID SYNTHESIS IN THE FAT BODY AND SOME TISSUES OF THE SILKWORM, Bombyx mori L. (LEPIDOPTERA: BOMBYCIDAE), INFECTED WITH NUCLEAR-POLYHEDROSIS VIRUS. Appl. Ent. Zool. 2, 3 (1967) 147-157.

The patterns and changes of nucleic acid synthetic activity during the course of nuclear-polyhedrosis were demonstrated in the fat body and some other tissues of the silkworm larva (B. mori L.) by means of autoradiography with ^{3}H-thymidine and uridine as nucleic acid precursors. The results indicated that both activities of DNA and RNA syntheses in the infected nucleus of the fat body increased progressively up to a point just prior to the polyhedra development. Beyond this period, there was a sudden breakdown of DNA synthesis, while the activity of RNA synthesis decreased gradually with the polyhedral growth. Some of the newly synthesised RNA in the diseased nuclei seemed to be adsorbed onto polyhedra during their formation. Essentially the same pattern of nucleic-acid synthesis was noted in the other infected tissues such as hypodermis, muscle and tracheal epithelium. (Auth.)

353 Watanabe, H. SITE OF VIRAL RNA SYNTHESIS WITHIN THE MIDGUT CELLS OF THE SILKWORM, Bombyx mori, INFECTED WITH CYTOPLASMIC-POLYHEDROSIS VIRUS. J. invertebrate Path. 9 (1967) 480-487.

The pattern of nucleic acid synthetic activity within the midgut cells of healthy larvae of the silkworm, B. mori, and of larvae infected with the cytoplasmic-polyhedrosis virus was demonstrated by means of autoradiography with labelled nucleic acid precursors. 5 h after injection of uridine-^{3}H, the healthy cells generally incorporated the labelled material into cytoplasmic RNA and partly into nucleic RNA, whereas the diseased cells on the 2nd to the 5th day after virus inoculation incorporated much of the labelled uridine into nucleic RNA and some into cytoplasmic RNA. In the nuclei of virus-infected cells, the nucleic label appeared most densely over the nucleoli. Thus the distinct difference in the uptake of the RNA precursor between the healthy and infected cells indicated that the nucleolus of the infected cell may be a site of the viral RNA synthesis. Autoradiograms with thymidine-^{3}H revealed no essential difference in the pattern of DNA synthesis between healthy and diseased midguts, and only a few cells incorporated the labelled material into their nuclei. At the late stage of virus infection, however, when some infected midgut cells eventually degenerated, there was a slight increase in the nucleic label in the newly generated cells. (Auth.)

354 Wattiaux, J.M., Lamborot, M. INFLUENCE OF AGING ON THE RATE OF INCORPORATION OF TRITIATED THYMIDINE IN THE NURSE CELLS OF Drosophila melanogaster. Curr. Mod. Biol. 1, 1 (1967) 5-8.

The rate of incorporation of thymidine-^{3}H in polyploid nurse cells was studied in 3-d-old and 3-week-old inbred Nettlebed strain of D. melanogaster. The ovaries were labelled by 10 min incubation at 25°C in a solution containing 0.17 M NaCl, 0.005M KCl, 0.002M $CaCl_2$, and 5 μCi of thymidine-^{3}H/ml. The speed and probably the duration of DNA synthesis increased with the degree of ploidy in both young and old flies. Old flies were less heavily labelled than young flies; this might be due to an increase of precursor pool size or a reduction of DNA synthesis with age. (CA 67:1967, 30173j)

355 Williams, C.M. DNA SYNTHESIS AND HORMONAL CONTROL OF INSECT METAMORPHOSIS. Science, N.Y. 148 (1965) 670. Paper presented at the "Annual Meeting of the National Academy of Sciences, Washington, D.C., USA. 26-28 Apr. 1965".

The epidermal tissues of diapausing pupae show no detectable DNA synthesis even after months of exposure to ^{3}H-thymidine. By contrast, very rapid synthesis occurs in synchrony with the termination of diapause and the initiation of adult development. The synthesis of DNA is, therefore, one of the most impressive biochemical changes associated with the action of the prothoracic gland hormone (ecdysone) in terminating the pupal diapause. DNA synthesis is known to require formation of the triphosphate derivatives of all four deoxyribonucleosides. Consequently, by virtue of its inhibition of the enzyme thymidylate synthetase, the compound 5'-fluoro-2'-deoxyuridine (FUDR) is recognized as a potent inhibitor of DNA synthesis. Diapausing pupae of the cecropia silkworm show almost unparalleled resistance to FUDR, and are seemingly undisturbed by injection of 5 mg into 5 g pupae. However, the drug singles out and apparently destroys all spindle-shaped haemocytes, one of the few cell types which normally continues to synthesize DNA during diapause; it also blocks the healing of integumentary wounds. When ecdysone is secreted to provoke the termination of diapause and the initiation of adult development, the insect becomes extremely sensitive to FUDR: a single

injection of 1 to 2 mg is capable of blocking the termination of diapause without killing. Moreover, administration of the drug at any stage during the first few days of adult development causes cessation of further development. The findings suggest a close connection between the synthesis of DNA and the action of ecdysone. (Abstr.)

356 Wyatt, G.R. Science, N.Y. 154 (1966) 251. Presented at the "Conference on Insect Endocrines, Brno, Czechoslovakia. 22 - 26 Aug. 1966".

Studies of DNA-, RNA-, and protein synthesis in the wing epithelial cells of cecropia pupae which had been induced to end their diapause through increase of temperature or injection of ecdysone. ^{3}H-uridine was used. Measurements of uridine incorporation and of template activity suggest that there is first a selective synthesis of template RNA followed by selective synthesis of ribosomal RNA. The rate of protein and DNA synthesis rises some hours after the rise in the rate RNA synthesis. New RNA synthesis appeared to be much closer to the primary action of ecdysone than DNA synthesis is.

357 Yoon, S.B., Fox, A.S. PERMEABILITY OF PREMATURE EGGS FROM Drosophila COLLECTED WITH THE "OVITRON". Nature, Lond. 206 (1965) 910-913.

The permeability of ovariolar eggs, and the development of the "ovitron" is described which permits the collection of large numbers of such eggs through the induction of premature discharge by females. Drosophila-DNA labelled with ^{32}P was prepared from wild-type flies grown on medium containing labelled orthophosphate. Eggs were collected in the ovitron for a 4-h period, dechorionated, and divided into batches, each batch being immersed in 5 ml of a solution containing 0.7 mg of ^{32}P-DNA in 0.16 M NaCl, and incubated at 25°C for 16 h. ^{32}P derived from labelled DNA could be shown to penetrate into the eggs. The minimal frequency of such unequivocally labelled eggs was 2.5 and 0.6%. Similar results were obtained with ^{32}P-DNA from Escherichia coli and from Proteus vulgaris. In later experiments the eggs were treated differently. A dialysis bag was used, containing 0.2 mg ^{32}P-DNA from E. coli in a total volume of 5 ml of modified Ringer, dialysis being carried out for 20 h at 23°C, with constant stirring. Autoradiograms of heavily labelled eggs thus obtained disclosed a heavy deposition of grains inside the vitelline membrane, especially at the anterior end, and grains arranged in radiating fibres on the outside. Radioactivity from ^{32}P-DNA which had entered the premature eggs was found in the cytoplasm and is incorporated into nuclei. Some of the ^{32}P probably enters the eggs in relatively large portions of DNA, part of this DNA remaining in the nucleus.

358 Yoon, S.B., Fox, A.S. PERMEABILITY OF PREMATURE Drosophila EGGS TO MACROMOLECULES. Genetics 50, 2 (1964) 296. Paper presented at the "1964 Meeting of the Genetics Society of America. Boulder, Colo., USA, 24 - 26 Aug. 1964".

By the use of a special device, the ovitron, it is possible to induce Drosophila females to lay oocytes of stages 13 and 14 prematurely. These eggs are fertilized, develop normally, and can be collected in large numbers at uniform developmental stages beginning with the pronuclear stage. They differ from mature eggs in a number of respects, but most significantly with regard to permeability. Dyes like methylene blue enter freely, and their contents are autolysed when they are immersed in solutions of proteolytic enzymes. When immersed in solutions of ^{32}P-labelled E. coli or Drosophila DNA, fixed, sectioned, and examined by autoradiography, the radioactive label is found in high concentration in the peripheral cytoplasm. The details of grain distribution suggest that the label enters in long tracts of DNA. At the pronuclear stage it is found clustered around and in the pronucleus. At later multicellular stages it persists in nuclei, but little if any is found in the cytoplasm. (Abstr.)

359 Zalokar, M. ETUDES DE LA FORMATION DE L'ACIDE RIBONUCLEIQUE ET DES PROTEINES CHEZ LES INSECTES. Revue suisse Zool. 72, 1 (1965) 241-261.

La localisation de la formation de l'ARN et des protéines dans les cellules des Insectes a été étudiée par le moyen de l'autoradiographie. Les précurseurs radioactifs furent utilisés: Uridine-^{3}H, uniformément marqué, 640 mCi/mM, dans une solution contenant 40 µg/ml; Cytidine-^{3}H, 7810 mCi/mM; DL-Leucine-4,5-^{3}H, 3570 mCi/mM, 74 µg/ml; Glycine-2-^{3}H, 44.2 mCi/mM, 100 µg/ml. Après l'administration des précurseurs radioactifs (^{3}H-uridine) les chromosomes et les nucléoles de la glande salivaire de Drosophila et des ovocytes de Blattella se chargent simultanément d'ARN radioactif. L'actinomycine D inhibe la production de l'ARN à des concentrations plus basses pour les nucléoles que pour les chromosomes. La production de l'ARN dans les nucléoles

est donc indépendante de celle des chromosomes. Puisque l'ARN nucléolaire est produit, chez Blattella, près de la chromatine associée aux nucléoles, sa production dépend probablement toujours de l'ADN. Si les nucléoles apparaissent toujours plus radioactifs que le reste du noyau, c'est parce qu'ils produisent l'ARN à un taux plus élevé que les chromosomes et l'accumulent en concentration plus grande. Dans toutes les cellules des Insectes étudiés, les noyaux se chargent d'ARN radioactif bien avant le cytoplasme. Chez la mouche et chez la chenille de Malacosoma, l'uridine injecté se détruit rapidement par catabolisme, ce qui permet de suivre l'évolution de l'ARN produit dans le noyau après la disparition du précurseur externe. Après quatre à six heures, les noyaux perdent de leur radioactivité, alors que le cytoplasme continue à s'en charger. Le cytoplasme des ovocytes de Drosophila n'est certainement pas capable de synthétiser l'ARN, puisqu'il est évident que tout son ARN lui est apporté par les cellules nourricières. Le noyau de l'ovocyte peut seulement produire une quantité minime d'ARN. De même, les ovocytes des ovaires méroïstiques des Lépidoptères (Galleria) ne produisent pas d'ARN. D'autre part, l'ovaire méroïstique d'une Nématocère, Simulium, possède des ovocytes dont les noyaux sont aussi actifs dans la formation de l'ARN que ceux des cellules nourricières. Après l'administration des acides aminés radioactifs, le cytoplasme est le premier à se charger de protéines radioactives. Dans toutes les cellules étudiées, le noyau devient radioactif après un délai de quelques minutes et c'est dans le nucléole que la radioactivité est d'abord la plus grande. Ces expériences prouvent que le cytoplasme est le lieu primaire de la synthèse des protéines et que cytoplasme est le lieu primaire de la synthèse des protéines et que les protéines du noyau sont probablement synthétisées dans le nucléole et en partie au moins, dans le cytoplasme. Chez Malacosoma, la soie est produite dans le cytoplasme et non dans les noyaux, indiquant que l'ARN responsable de sa production est actif seulement dans le cytoplasme. Quand, dans les glandes séricigènes, la formation de l'ARN est totalement inhibée par l'actinomycine D pendant quatre heures, la soie continue à se produire. Si un ARN messager est nécessaire à la production de la soie, il devrait être relativement stable.

See also:

15 The elimination and differentiation of chromosomes in the germ line of Sciara. (Rieffel, S.M. et al., 1966)

16 A molecular explanation of the bobbed mutants of Drosophila as partial deficiencies of "ribosomal" DNA. (Ritossa, F.M. et al., 1966)

21 Scintillation counting of tritiated thymidine transferred to females by labelled Drosophila melanogaster males. (Trout, W.E., III., 1966)

29 Somatic mutations in the moth Ephestia. Report on Research, August 1, 1965 - September 15, 1966. (Caspari, E.W., 1966)

33 Distribution of lethals induced by tritiated DNA precursors in Drosophila melanogaster. (Kaplan, W.D. et al., 1966)

35 The production of mosaics by incorporation of P^{32} into DNA of Drosophila melanogaster spermatozoa. (Lee, W.R. et al., 1967)

36 Mutations produced by transmutation of phosphorus-32 to sulfur-32 within Drosophila DNA. (Lee, W.R. et al., 1967)

40 Some biochemical aspects of insect metamorphosis. (Gilbert, L.I. et al., 1961)

43 Metabolic control mechanisms in insects. (Harvey, W.R. et al., 1966)

72 Specific activity increase in a Balbiani ring in isolated cell nuclei of Chironomus by means of Mg^{2+}. (Lezzi, M., 1967)

92 Glycogen accumulation during oogenesis and its premature release by blocking of the RNA supply. (Study on Musca domestica L.) (Engels, W. et al., 1967)

115 The hormone ecdysone as effector of specific changes in the pattern of gene activities of Drosophila hydei. (Berendes, H.D., 1967)

116 Amino acid incorporation into giant chromosomes of D. hydei. (Berendes, H.D., 1967)

145 Gene activation without histone acetylation in Drosophila melanogaster. (Ellgaard, E.G., 1967)

157 Inhibition by certain pteridines of ribosomal RNA and DNA synthesis in developing Oncopeltus eggs. (Harris, S.E. et al., 1967)

169 Biochemical mechanisms of hormone action. (Karlson, P., 1961)

170 Biochemistry and mode of action of ecdysone. (Karlson, P., 1964)

173 The effects of ecdysone on giant chromosomes, RNA metabolism and enzyme induction. (Karlson, P., 1967)

176 Action of ecdysone on some metabolism during larval-pupal transformation of the housefly, Musca domestica L. (Diptera: Muscidae). (Kobayashi, M. et al., 1967)

202 Utilization of orotate-^{14}C in the biosynthesis of pyrimidines in Helix pomatia and Celerio euphorbia. (Porembska, Z. et al., 1966)

217 The effect of ecdysone on RNA and protein metabolism in insects. (Sekeris, C.E., 1967)

416 Study on the function of nurse cells in meroistic insect ovaries, with special reference to oogensis in adephagous Coleoptera. (Bier, K., 1965)

417 Oogenesis, the growth of giant cells. (Bier, K., 1967)

418 Structure and function of oocyte chromosomes and nucleoli and extra-DNA during the oogenesis of panoistic and meroistic insects. (Bier, K. et al., 1967)

422 An investigation of somatic reduction division in the hind-gut of the mosquito Aedes aegypti (L.) using tritium labelled thymidine. (Cronin, R.T., 1966)

423 Incorporation de la thymidine tritiée dans l'acide deoxyribonucléique des glandes sericigènes chez le ver à soie. (Daillie, J., 1960)

424 Métabolisme de la thymidine dans la glande sericigène du ver à soie. I. Les principales voies suivies par le précurseur dans la glande incubée "in vitro". (Daillie, J., 1967)

425 Métabolisme de la thymidine dans la glande sericigène du ver à soie. II. Utilisation des nucléotides radioactifs pour la synthèse de l'ADN dans la glande incubée "in vitro" au 4e jour du 5e stade. (Daillie, J., 1967)

426 Métabolisme de la thymidine dans la glandes sericigène du ver à soie. III. Incorporation dans la glande sericigène prelevée au 6ejour ou 5e âge et incubée "in vitro". (Daillie, J., 1967)

427 Métabolisme de la thymidine dans la glande sericigène du ver à soie. IV. Etudes sur la glande "in situ". (Daillie, J. 1967)

431 Radioautographic studies on the gonads of Acheta domesticus (L.). (Halkka, O. et al., 1966)

436 Contribution a l'étude du métabolisme des glandes sericigènes de Bombyx mori, incubées in vitro. (Prudhomme, J.C., 1966)

437 Effects of 6-azauridine on the development of the ovaries in the house fly "Musca domestica L." (Diptera). (Rezabova, B., et al., 1967)

439 Drosophila salivary glands in vitro. (Tulchin, N.W., 1966)

447 Studies on oogenesis in Drosophila melanogaster with ^{3}H-thymidine label. (Chandley, A.C., 1966)

448 H^{3}-Thymidine radioautographic study of spermatogenesis in the boll weevil, Anthonomus grandis (Coleoptera: Curculionidae). (Chang, T.-H. et al., 1967)

449 Puffing in giant chromosomes of Diptera and the mechanism of its control. (Clever, U., 1963)

450 Control of chromosome puffing. (Clever, U., 1967)

453 Oogenesis in Hyalophora cecropia. (King, R.C. et al., 1965)

538 Chromosome breakage associated with infection. II. Stained sections. (Halkka, O. et al., 1967)

887 The effect of apholate and thiotepa on nucleic acid synthesis and nucleotide ratios in housefly eggs. (Painter, R.R. et al., 1967)

928 Cytological evaluation of dose-rate effects of radiation on mutation frequency of silkworm gonia. I. Kinetics of proliferation and killing of spermatogonia during chronic irradiation. (Sado, T., 1966)

997 Studies of early effects of radiation on chromosomes and mitosis. Progress Report, March 1, 1966-February 28, 1967. (Carlson, J.G., 1967)

1725 Quantitative biophysical and cytochemical studies of polytene chromosomes. (Paul, J.S., 1966)

1.2.6. Lipids and Fatty Acids. Sterol and Steroid Metabolism

360 Allais, J.P., Barbier, M. UTILIZATION OF β-SITOSTEROL-28,29-$^{14}C_2$ BY THE LOCUST, Locusta migratoria. C.r. hebd. Séanc. Acad. Sci., D 263 (1966) 1252-1254. (In French)

Cholesterol was identified by mass spectroscopy as the major sterol present in L. migratoria. Locusts fed β-sitosterol-28,29-$^{14}C_2$ transformed this sterol very slowly and non-quantitatively into cholesterol.

The ^{14}C could not be detected in the respired CO_2 or in various volatile organic acids present in the lipids of the locust. (CA 66: 1967, 17339c)

361 Brak, J.A.W., Vonk, H.J., Daniels, F.J.A. BIOSYNTHESIS OF THE FATTY ACIDS IN ASEPTICALLY REARED LARVAE OF THE BLOWFLY Calliphora erythrocephala. Archs int. Physiol. Biochim. 74, 5 (1966) 821-829.

The incorporation of Na acetate-1-^{14}C into fatty acids by the 5-d-old larva of the blowfly (C. erythrocephala) was studied. The larva were not able to synthesise linoleic acid. The larva were capable of dehydrogenating saturated fatty acids to corresponding monoenoic acids. In the larva, the de novo synthesis and elongation system of fatty acids were operative; however, the end product of the de novo synthesis in this animal was mainly myristic acid and not palmitic acid. (CA 66: 1967, 35675p)

362 Candy, D.J. OCCURRENCE AND METABOLISM OF SCYLLOINOSITOL IN THE LOCUST. Biochem. J. 103, 3 (1967) 666-671.

A simple method for the identification of scylloinositol is described; this compound was identified as a component of locust (Schistocerca gregaria) haemolymph where it occurs in concentrations of 0.2 - 0.4 mg/ml. The same method was used to demonstrate the presence of scylloinositol in five other insect species (Locusta migratoria, Periplaneta americana, P. australasiae, Blaberus sp. and Calliphora sp.). Locust phospholipids contain myoinositol but no scylloinositol. - (0.02 ml saline containing 10 μCi of D-(U-^{14}C) glucose was injected into the thoracic haemocoel of an adult male locust 7 d after final moult. Radioactivity was incorporated into myoinositol and scylloinositol in vivo. (U-^{14}C) myoinositol was used in other experiments. Extracts of locust fat body catalyse the conversion of myoinositol into scylloinositol. This seems to take place by a 2-step process in which myoinositol is first oxidized with NAD^+ to myoinosose-2, and the myoinosose-2 is stereospecifically reduced with NADPH to scylloinositol.

363 Chino, H., Sudo, A., Harashima, K. ISOLATION OF DIGLYCERIDE-BOUND LIPOPROTEIN FROM INSECT HEMOLYMPH. Biochim. biophys. Acta 144, 1 (1967) 117-179.

The diglyceride released from insect fat body was previously found by the authors to be firmly bound to a specific haemolymph protein, to form a "diglyceride-bound lipoprotein". This protein is suggested to be the only possible means by which insects transport long-chain fatty acids from the fat body to the site of utilization. It has now been isolated, using the pupal haemolymph of the silkworm, Philosamia cynthia. (1-^{14}C) palmitic acid (5×10^5 cpm, 0.02 μM) was injected into the pupa. The palmitic acid is first incorporated into the glyceride fraction (mainly tri- and diglyceride) in the fat body, and only then is ^{14}C-diglyceride released rapidly and specifically into the haemolymph (here, $\sim 5 \times 10^4$ cpm of diglyceride for 1 ml of haemolymph). The lipoprotein was subsequently isolated, the steps being described. It is a globulin-like protein. Its precipitation depends not only on the ionic strength but also on the pH, the optimal pH for precipitation being $\sim$6.5. The lipoprotein is deep yellow, the colour representing carotenoid pigment (s). The solubility curve of the lipoprotein strongly suggests that both diglyceride and carotenoid are conjugated to a single protein.

364 Clayton, R.B., Hinkle, P.C., Smith, D.A., Edwards, A.M. THE INTESTINAL ABSORPTION OF CHOLESTEROL, ITS ESTERS AND SOME RELATED STEROLS AND ANALOGUES IN THE ROACH, Eurycotis floridana. Comp. Biochem. Physiol. 11 (1964) 333-350.

Commercially obtained 4-^{14}C-cholesterol, 4-^{14}C-Δ^4-cholesten-3-one, and 7α-^3H-cholesterol of high specific activity were purified and diluted. Other compounds were prepared from them as follows: 7α-^3H-cholestanol via 7α-^3H-cholesteryl acetate by hydrogenation; 7α-^3H-epicholestanol from 7α-^3H-cholesterol via 7α-^3H-cholestanone; 4-^{14}C-Δ^4-cholestenol from 4-^{14}C-Δ^4-cholesten-3-one; 4-^{14}C-Δ^7-cholestenol from 4-^{14}C-cholesterol via 4-^{14}C-7-dehydrocholesterol, 7α-^3H-cholesteryl methyl ether from 7α-^3H-cholesterol; 4-^{14}C-cholesteryl chloride from 4-^{14}C-cholesterol; 3α-^3H-sitosterol from B-sitosterol; and 3α-^3H-sitosterol via its digitonide. Individual insects showed considerable quantitative variability in handling sterols and sterol analogues fed to them. A differential double labelling technique has therefore been generally used, in which cholesterol and another sterol, ester or analogue, each differently labelled with ^3H or ^{14}C, are fed simultaneously to the same animal, the fate of the ingested cholesterol serving as internal standard. Specific activities of 5000 dpm ^{14}C and 20 000 dpm ^3H/mμM were used allowing an accuracy of $\pm$ 5% in

radioassay. Absorption of cholesterol from the intestinal tract of E. floridana was shown to occur predominantly in the crop but probably also in the gastric caeca. The amount absorbed is approx. proportional to the amount of cholesterol ingested over the range 0.05-500 μg. The role of esterification in the intestinal absorption of cholesterol was studied but remains incompletely defined. However, several lines of evidence suggest that esterification is not an obligatory event, though it may facilitate absorption at low dietary concentrations. Evidence is presented for the absorption of intact aliphatic cholesteryl esters from the gut. Cholestanol, cholesteryl methyl ether and cholesteryl chloride are absorbed about as efficiently as cholesterol. Δ^7-cholestenol is absorbed more efficiently, but β-sitosterol, Δ^4-cholestenol and epicholestanol are absorbed less efficiently than cholesterol. These findings are compared with those from similar studies in vertebrates.

365 Crone, H.D. TRIS BUFFER AS AN ETHANOLAMINE COMPETITOR IN THE METABOLISM OF PHOSPHATIDES. Biochem. J. 100, 1 (1966) 12P.

The calcium stimulated incorporation of (2-^{14}C)-ethanolamine and of serine into the phosphatides of the larval fat body of the house fly Musca domestica is being studied. During these investigations it was noticed that the rate of incorporation of ethanolamine was much less in tris (2-amino-2-hydroxymethylpropane-1,3-diol) buffer than in other buffers. Thus under comparable conditions at pH7.4 in 10mM-$CaCl_2$, 17 mM-tris-HCl gave a rate of 6×10^{-9} moles/h/g of larvae, 75 mM-sodium diethylbarbiturate-HCl gave 29×10^{-9} moles/h/g and 42 mM-imidazole-HCl gave a rate of 32×10^{-9} moles/h/g. Using tris buffer, an apparent K_m value for both ethanolamine and serine of 2×10^{-3} M was obtained. The incorporation of ethanolamine at two concentrations of tris buffer (13mM and 112mM) was studied. The graph of the reciprocals of velocity against ethanolamine concentration gave two straight lines intersecting at the 1/v axis, the conditions for competitive inhibition. From this plot values of 1.7×10^{-4} M for the K_m of ethanolamine, and of 1.8×10^{-3} M for the K of tris were obtained. It is apparent that the relatively high concentration of tris is competing with the ethanolamine to depress the rate of incorporation. The apparent K_m value observed for ethanolamine and serine in the tris buffer is therefore largely that of tris. (From abstr.)

366 Crone, H.D. THE CALCIUM-STIMULATED INCORPORATION OF ISOTOPIC SERINE AND ETHANOLAMINE INTO THE PHOSPHOLIPIDS OF HOUSEFLY (Musca domestica) LARVAE. Biochem. J. 102, 1 (1967) 4P-5P. "Proceedings of the Biochemical Society, Slough, England. 12 Nov. 1966".

The incorporation of (2-^{14}C)ethanolamine and L-(3-^{14}C)serine into the phospholipids in homogenates of the fat bodies of larval house flies has been studied. This incorporation is dependent on the calcium ion concentration, maximal rates being obtained at 20 mM in imidazole buffer. Mg will not replace Ca, but is not directly inhibitory. Mn, Zn, and ions at 10 mM completely inhibit incorporation. The pH optimum in veronal buffer lies between 7.25 and 8.25, beyond these points the activity falls off sharply. The incorporation is greatly reduced by 1 mM-cetyltrimethylammonium bromide and by 0.1% Triton X-100. Serine and ethanolamine both have K_m values of 2×10^{-4} M when measured in imidazole buffer with 10 mM calcium. The incorporation of the radioactive serine or ethanolamine is judged to be a direct exchange with existing nitrogenous bases on the phospholipids, rather than a reflexion of net synthesis of the lipids. This is because of the kinetics of the incorporation, which do not favour the presence of intermediates, and because the incorporation is Ca dependent, whereas the incorporation of (^{32}P) phosphorylethanolamine in the same system is stimulated by Mg and not by Ca. In the present work the results are in accord with the presence of one enzymic system exchanging ethanolamine, serine and foreign aminoalcohols with the bases of phospholipids, the precise nature of which has not been elucidated.

367 Crone, H.D. THE CALCIUM-STIMULATED INCORPORATION OF ETHANOLAMINE AND SERINE INTO THE PHOSPHOLIPIDS OF THE HOUSEFLY Musca domestica. Biochem. J. 104, 2 (1967) 695-704.

The Ca-stimulated incorporation of (2-^{14}C)ethanolamine and L-(3-^{14}C)-serine (initial specific radioactivity of 4.86 and 4.6 mCi/mM, respectively) into the phospholipids of homogenates of the fat bodies from larval house flies (M. domestica) was studied. Ethanolamine and serine acted as competitive inhibitors with one another. N-Methylethanolamine was not distinguished from ethanolamine by the system. Tris buffer was also a competitor with these compounds, and a number of other amino alcohols were inhibitory, probably competitively. (^{32}P)Phosphorylethanolamine

(initial specific radioactivity 100 mCi/mM) was prepared from ethanolamine, orthophosphoric acid and (^{32}P)orthophosphate solution. The incorporation of (^{32}P) phosphorylethanolamine into phospholipids was observed in suspensions of whole fat bodies. This incorporation was stimulated by Mg. During the incubation of the homogenates, a Ca-stimulated breakdown of phospholipids by a phospholipase A occurred. These results are compared with results published for similar mammalian systems, and their possible physiological significance is discussed.

368 Crone, H.D. THE RELATIONSHIP BETWEEN PHOSPHATIDE SERINE AND ETHANOLAMINE IN LARVAE OF THE HOUSEFLY, Musca domestica. J. Insect Physiol. 13 (1967) 81-90.

The incorporation of L-(3-^{14}C) serine into the phosphatides of M. domestica larvae was examined in vivo, and of this compound and [2-^{14}C]ethanolamine in vitro, using whole fat body preparations. Rapid incorporation, probably by an exchange reaction, was observed in both cases. Lipid serine was the direct precursor of lipid ethanolamine over the short time periods studied. Ethanolamine depressed the incorporation of serine but the reverse effect was not shown. These results are discussed in relation to current ideas of mammalian phosphatide metabolism. (Auth.)

369 D'Costa, M., Birt, L.M. THE OXIDATION OF FATTY ACIDS BY THORACIC TISSUES DURING THE DEVELOPMENT OF THE BLOWFLY Lucilia cuprina. Biochem. J. 104, 1 (1967) 11P.

Evidence shows that the developing thorax of Lucilia contains a particulate, carnitine-dependent system capable of oxidizing fatty acids, which virtually disappears at maturity. The oxidation of butyrate (25 mM) by a particulate preparation isolated from a filtered homogenate of bisected Lucilia thoraces required a 4-carbon acid (e.g. malate, 0.5 mM) and was stimulated by ATP (2mM). The rates of O_2 uptake, corrected for the endogenous respiration which itself appeared to be due to fatty acid oxidation, were 10-20 µl of O_2/mg protein/h. CoA, carnitine or serum albumin did not increase O_2 uptake; butyryl carnitine was not oxidized more rapidly than butyrate. Palmitate oxidation was stimulated by all these cofactors. There was a considerable dependence on carnitine and the O_2 uptake with palmitylcarnitine (50-80 µl of O_2/mg protein/h) was considerably greater than with any system where palmitate itself was the substrate (10-20 µl of O_2/mg protein/h). The distribution of the active particles during centrifuging in density gradients suggests that the developing sarcosomes themselves are responsible for the oxidation. As judged by $^{14}CO_2$ released from labelled fatty acids, the oxidase system appears about 2.5 d before adult emergence, reaches max. activity at about emergence, then declines to an extremely low level as the fly matures. Freezing and thawing the mitochondria from mature flies did not increase the oxidation which, therefore, does not appear to be limited by sarcosomal impermeability. Thus the oxidase system is active only during the period of adult formation. Its appearance and disappearance enables the fly to energise its thoracic development at the expense of pupal reserves of fat, which are unable to support adult flight. Conversely, the smaller reserves of carbohydrate are conserved to provide the energy for flight after emergence, a process in which carnitine may also be concerned.

370 Dutky, R.C., Robbins, W.E., Shortino, T.J., Kaplanis, J.N., Vroman, H.E. THE CONVERSION OF CHOLESTANONE TO CHOLESTANOL BY THE HOUSEFLY, Musca domestica L. J. Insect Physiol. 13, 10 (1967) 1501-1510.

Larvae of the house fly, M. domestica L., reared aseptically on a semi-defined diet failed to develop when either cholestenone, cholestanone, or cholestanol was used as the sole source of dietary steroid. However, when these three steroids were tested for 'sparing' activity (in combination with a sub-minimal quantity of cholesterol) cholestanone and cholestanol were 66 and 79%, respectively, as effective as an optimum concentration of cholesterol. Under the same conditions cholestenone showed only low biological activity (11%). Biochemical studies with 4-^{14}C-cholestanone indicate that the utilization of this steroid in the house fly larvae proceeds through its partial conversion to cholestanol. The 4-^{14}C-cholestanone used was prepared from 4-^{14}C-cholesterol by hydrogenation to cholestanol. The identity of cholestanol as a metabolite of cholestanone was established by radiotracer techniques, gas-liquid chromatographic analysis, and by isolation of crystalline cholestanol from house fly pupae reared aseptically on a semi-defined diet containing cholestanone plus a subminimal amount of cholesterol. Using reverse isotope dilution techniques, no significant conversion of ^{14}C-cholestanone to cholesterol was detected. In studies with adult insects, both males and females converted injected ^{14}C-cholestanone to cholestanol. (Essentially auth.)

injection of 1 to 2 mg is capable of blocking the termination of diapause without killing. Moreover, administration of the drug at any stage during the first few days of adult development causes cessation of further development. The findings suggest a close connection between the synthesis of DNA and the action of ecdysone. (Abstr.)

356 Wyatt, G.R. Science, N.Y. 154 (1966) 251. Presented at the "Conference on Insect Endocrines, Brno, Czechoslovakia. 22 - 26 Aug. 1966".

Studies of DNA-, RNA-, and protein synthesis in the wing epithelial cells of cecropia pupae which had been induced to end their diapause through increase of temperature or injection of ecdysone. ^{3}H-uridine was used. Measurements of uridine incorporation and of template activity suggest that there is first a selective synthesis of template RNA followed by selective synthesis of ribosomal RNA. The rate of protein and DNA synthesis rises some hours after the rise in the rate RNA synthesis. New RNA synthesis appeared to be much closer to the primary action of ecdysone than DNA synthesis is.

357 Yoon, S.B., Fox, A.S. PERMEABILITY OF PREMATURE EGGS FROM Drosophila COLLECTED WITH THE "OVITRON". Nature, Lond. 206 (1965) 910-913.

The permeability of ovariolar eggs, and the development of the "ovitron" is described which permits the collection of large numbers of such eggs through the induction of premature discharge by females. Drosophila-DNA labelled with ^{32}P was prepared from wild-type flies grown on medium containing labelled orthophosphate. Eggs were collected in the ovitron for a 4-h period, dechorionated, and divided into batches, each batch being immersed in 5 ml of a solution containing 0.7 mg of ^{32}P-DNA in 0.16 M NaCl, and incubated at 25°C for 16 h. ^{32}P derived from labelled DNA could be shown to penetrate into the eggs. The minimal frequency of such unequivocally labelled eggs was 2.5 and 0.6%. Similar results were obtained with ^{32}P-DNA from Escherichia coli and from Proteus vulgaris. In later experiments the eggs were treated differently. A dialysis bag was used, containing 0.2 mg ^{32}P-DNA from E. coli in a total volume of 5 ml of modified Ringer, dialysis being carried out for 20 h at 23°C, with constant stirring. Autoradiograms of heavily labelled eggs thus obtained disclosed a heavy deposition of grains inside the vitelline membrane, especially at the anterior end, and grains arranged in radiating fibres on the outside. Radioactivity from ^{32}P-DNA which had entered the premature eggs was found in the cytoplasm and is incorporated into nuclei. Some of the ^{32}P probably enters the eggs in relatively large portions of DNA, part of this DNA remaining in the nucleus.

358 Yoon, S.B., Fox, A.S. PERMEABILITY OF PREMATURE Drosophila EGGS TO MACROMOLECULES. Genetics 50, 2 (1964) 296. Paper presented at the "1964 Meeting of the Genetics Society of America. Boulder, Colo., USA, 24 - 26 Aug. 1964".

By the use of a special device, the ovitron, it is possible to induce Drosophila females to lay oocytes of stages 13 and 14 prematurely. These eggs are fertilized, develop normally, and can be collected in large numbers at uniform developmental stages beginning with the pronuclear stage. They differ from mature eggs in a number of respects, but most significantly with regard to permeability. Dyes like methylene blue enter freely, and their contents are autolysed when they are immersed in solutions of proteolytic enzymes. When immersed in solutions of ^{32}P-labelled E. coli or Drosophila DNA, fixed, sectioned, and examined by autoradiography, the radioactive label is found in high concentration in the peripheral cytoplasm. The details of grain distribution suggest that the label enters in long tracts of DNA. At the pronuclear stage it is found clustered around and in the pronucleus. At later multicellular stages it persists in nuclei, but little if any is found in the cytoplasm. (Abstr.)

359 Zalokar, M. ETUDES DE LA FORMATION DE L'ACIDE RIBONUCLEIQUE ET DES PROTEINES CHEZ LES INSECTES. Revue suisse Zool. 72, 1 (1965) 241-261.

La localisation de la formation de l'ARN et des protéines dans les cellules des Insectes a été étudiée par le moyen de l'autoradiographie. Les précurseurs radioactifs furent utilisés: Uridine-^{3}H, uniformément marqué, 640 mCi/mM, dans une solution contenant 40 µg/ml; Cytidine-^{3}H, 7810 mCi/mM; DL-Leucine-4,5-^{3}H, 3570 mCi/mM, 74 µg/ml; Glycine-2-^{3}H, 44.2 mCi/mM, 100 µg/ml. Après l'administration des précurseurs radioactifs (^{3}H-uridine) les chromosomes et les nucléoles de la glande salivaire de Drosophila et des ovocytes de Blattella se chargent simultanément d'ARN radioactif. L'actinomycine D inhibe la production de l'ARN à des concentrations plus basses pour les nucléoles que pour les chromosomes. La production de l'ARN dans les nucléoles

est donc indépendante de celle des chromosomes. Puisque l'ARN nucléolaire est produit, chez Blattella, près de la chromatine associée aux nucléoles, sa production dépend probablement toujours de l'ADN. Si les nucléoles apparaissent toujours plus radioactifs que le reste du noyau, c'est parce qu'ils produisent l'ARN à un taux plus élevé que les chromosomes et l'accumulent en concentration plus grande. Dans toutes les cellules des Insectes étudiés, les noyaux se chargent d'ARN radioactif bien avant le cytoplasme. Chez la mouche et chez la chenille de Malacosoma, l'uridine injecté se détruit rapidement par catabolisme, ce qui permet de suivre l'évolution de l'ARN produit dans le noyau après la disparition du précurseur externe. Après quatre à six heures, les noyaux perdent de leur radioactivité, alors que le cytoplasme continue à s'en charger. Le cytoplasme des ovocytes de Drosophila n'est certainement pas capable de synthétiser l'ARN, puisqu'il est évident que tout son ARN lui est apporté par les cellules nourricières. Le noyau de l'ovocyte peut seulement produire une quantité minime d'ARN. De même, les ovocytes des ovaires méroïstiques des Lépidoptères (Galleria) ne produisent pas d'ARN. D'autre part, l'ovaire méroïstique d'une Nématocère, Simulium, possède des ovocytes dont les noyaux sont aussi actifs dans la formation de l'ARN que ceux des cellules nourricières. Après l'administration des acides aminés radioactifs, le cytoplasme est le premier à se charger de protéines radioactives. Dans toutes les cellules étudiées, le noyau devient radioactif après un délai de quelques minutes et c'est dans le nucléole que la radioactivité est d'abord la plus grande. Ces expériences prouvent que le cytoplasme est le lieu primaire de la synthèse des protéines et que cytoplasme est le lieu primaire de la synthèse des protéines et que les protéines du noyau sont probablement synthétisées dans le nucléole et en partie au moins, dans le cytoplasme. Chez Malacosoma, la soie est produite dans le cytoplasme et non dans les noyaux, indiquant que l'ARN responsable de sa production est actif seulement dans le cytoplasme. Quand, dans les glandes séricigènes, la formation de l'ARN est totalement inhibée par l'actinomycine D pendant quatre heures, la soie continue à se produire. Si un ARN messager est nécessaire à la production de la soie, il devrait être relativement stable.

See also:

15 The elimination and differentiation of chromosomes in the germ line of Sciara. (Rieffel, S.M. et al., 1966)

16 A molecular explanation of the bobbed mutants of Drosophila as partial deficiencies of "ribosomal" DNA. (Ritossa, F.M. et al., 1966)

21 Scintillation counting of tritiated thymidine transferred to females by labelled Drosophila melanogaster males. (Trout, W.E., III., 1966)

29 Somatic mutations in the moth Ephestia. Report on Research, August 1, 1965 - September 15, 1966. (Caspari, E.W., 1966)

33 Distribution of lethals induced by tritiated DNA precursors in Drosophila melanogaster. (Kaplan, W.D. et al., 1966)

35 The production of mosaics by incorporation of P^{32} into DNA of Drosophila melanogaster spermatozoa. (Lee, W.R. et al., 1967)

36 Mutations produced by transmutation of phosphorus-32 to sulfur-32 within Drosophila DNA. (Lee, W.R. et al., 1967)

40 Some biochemical aspects of insect metamorphosis. (Gilbert, L.I. et al., 1961)

43 Metabolic control mechanisms in insects. (Harvey, W.R. et al., 1966)

72 Specific activity increase in a Balbiani ring in isolated cell nuclei of Chironomus by means of Mg^{2+}. (Lezzi, M., 1967)

92 Glycogen accumulation during oogenesis and its premature release by blocking of the RNA supply. (Study on Musca domestica L.) (Engels, W. et al., 1967)

115 The hormone ecdysone as effector of specific changes in the pattern of gene activities of Drosophila hydei. (Berendes, H.D., 1967)

116 Amino acid incorporation into giant chromosomes of D. hydei. (Berendes, H.D., 1967)

145 Gene activation without histone acetylation in Drosophila melanogaster. (Ellgaard, E.G., 1967)

157 Inhibition by certain pteridines of ribosomal RNA and DNA synthesis in developing Oncopeltus eggs. (Harris, S.E. et al., 1967)

169 Biochemical mechanisms of hormone action. (Karlson, P., 1961)

170 Biochemistry and mode of action of ecdysone. (Karlson, P., 1964)

173 The effects of ecdysone on giant chromosomes, RNA metabolism and enzyme induction. (Karlson, P., 1967)

176 Action of ecdysone on some metabolism during larval-pupal transformation of the housefly, Musca domestica L. (Diptera: Muscidae). (Kobayashi, M. et al., 1967)

202 Utilization of orotate-^{14}C in the biosynthesis of pyrimidines in Helix pomatia and Celerio euphorbia. (Porembska, Z. et al., 1966)

217 The effect of ecdysone on RNA and protein metabolism in insects. (Sekeris, C.E., 1967)

416 Study on the function of nurse cells in meroistic insect ovaries, with special reference to oogensis in adephagous Coleoptera. (Bier, K., 1965)

417 Oogenesis, the growth of giant cells. (Bier, K., 1967)

418 Structure and function of oocyte chromosomes and nucleoli and extra-DNA during the oogenesis of panoistic and meroistic insects. (Bier, K. et al., 1967)

422 An investigation of somatic reduction division in the hind-gut of the mosquito Aedes aegypti (L.) using tritium labelled thymidine. (Cronin, R.T., 1966)

423 Incorporation de la thymidine tritiée dans l'acide deoxyribonucléique des glandes sericigènes chez le ver à soie. (Daillie, J., 1960)

424 Métabolisme de la thymidine dans la glande sericigène du ver à soie. I. Les principales voies suivies par le précurseur dans la glande incubée "in vitro". (Daillie, J., 1967)

425 Métabolisme de la thymidine dans la glande sericigène du ver à soie. II. Utilisation des nucléotides radioactifs pour la synthèse de l'ADN dans la glande incubée "in vitro" au 4e jour du 5e stade. (Daillie, J., 1967)

426 Métabolisme de la thymidine dans la glandes sericigène du ver à soie. III. Incorporation dans la glande sericigène prelevée au 6ejour ou 5e âge et incubée "in vitro". (Daillie, J., 1967)

427 Métabolisme de la thymidine dans la glande sericigène du ver à soie. IV. Etudes sur la glande "in situ". (Daillie, J. 1967)

431 Radioautographic studies on the gonads of Acheta domesticus (L.). (Halkka, O. et al., 1966)

436 Contribution a l'étude du métabolisme des glandes sericigènes de Bombyx mori, incubées in vitro. (Prudhomme, J.C., 1966)

437 Effects of 6-azauridine on the development of the ovaries in the house fly "Musca domestica L." (Diptera). (Rezabova, B., et al., 1967)

439 Drosophila salivary glands in vitro. (Tulchin, N.W., 1966)

447 Studies on oogenesis in Drosophila melanogaster with ^{3}H-thymidine label. (Chandley, A.C., 1966)

448 H^{3}-Thymidine radioautographic study of spermatogenesis in the boll weevil, Anthonomus grandis (Coleoptera: Curculionidae). (Chang, T.-H. et al., 1967)

449 Puffing in giant chromosomes of Diptera and the mechanism of its control. (Clever, U., 1963)

450 Control of chromosome puffing. (Clever, U., 1967)

453 Oogenesis in Hyalophora cecropia. (King, R.C. et al., 1965)

538 Chromosome breakage associated with infection. II. Stained sections. (Halkka, O. et al., 1967)

887 The effect of apholate and thiotepa on nucleic acid synthesis and nucleotide ratios in housefly eggs. (Painter, R.R. et al., 1967)

928 Cytological evaluation of dose-rate effects of radiation on mutation frequency of silkworm gonia. I. Kinetics of proliferation and killing of spermatogonia during chronic irradiation. (Sado, T., 1966)

997 Studies of early effects of radiation on chromosomes and mitosis. Progress Report, March 1, 1966-February 28, 1967. (Carlson, J.G., 1967)

1725 Quantitative biophysical and cytochemical studies of polytene chromosomes. (Paul, J.S., 1966)

1.2.6. Lipids and Fatty Acids. Sterol and Steroid Metabolism

360 Allais, J.P., Barbier, M. UTILIZATION OF β-SITOSTEROL-28,29-$^{14}C_2$ BY THE LOCUST, Locusta migratoria. C.r. hebd. Séanc. Acad. Sci., D 263 (1966) 1252-1254. (In French)

Cholesterol was identified by mass spectroscopy as the major sterol present in L. migratoria. Locusts fed β-sitosterol-28,29-$^{14}C_2$ transformed this sterol very slowly and non-quantitatively into cholesterol.

The ^{14}C could not be detected in the respired CO_2 or in various volatile organic acids present in the lipids of the locust. (CA 66: 1967, 17339c)

361 Brak, J.A.W., Vonk, H.J., Daniels, F.J.A. BIOSYNTHESIS OF THE FATTY ACIDS IN ASEPTICALLY REARED LARVAE OF THE BLOWFLY Calliphora erythrocephala. Archs int. Physiol. Biochim. 74, 5 (1966) 821-829.

The incorporation of Na acetate-1-^{14}C into fatty acids by the 5-d-old larva of the blowfly (C. erythrocephala) was studied. The larva were not able to synthesise linoleic acid. The larva were capable of dehydrogenating saturated fatty acids to corresponding monoenoic acids. In the larva, the de novo synthesis and elongation system of fatty acids were operative; however, the end product of the de novo synthesis in this animal was mainly myristic acid and not palmitic acid. (CA 66: 1967, 35675p)

362 Candy, D.J. OCCURRENCE AND METABOLISM OF SCYLLOINOSITOL IN THE LOCUST. Biochem. J. 103, 3 (1967) 666-671.

A simple method for the identification of scylloinositol is described; this compound was identified as a component of locust (Schistocerca gregaria) haemolymph where it occurs in concentrations of 0.2 - 0.4 mg/ml. The same method was used to demonstrate the presence of scylloinositol in five other insect species (Locusta migratoria, Periplaneta americana, P. australasiae, Blaberus sp. and Calliphora sp.). Locust phospholipids contain myoinositol but no scylloinositol. - (0.02 ml saline containing 10 μCi of D-(U-^{14}C) glucose was injected into the thoracic haemocoel of an adult male locust 7 d after final moult. Radioactivity was incorporated into myoinositol and scylloinositol in vivo. (U-^{14}C) myoinositol was used in other experiments. Extracts of locust fat body catalyse the conversion of myoinositol into scylloinositol. This seems to take place by a 2-step process in which myoinositol is first oxidized with NAD^+ to myoinosose-2, and the myoinosose-2 is stereospecifically reduced with NADPH to scylloinositol.

363 Chino, H., Sudo, A., Harashima, K. ISOLATION OF DIGLYCERIDE-BOUND LIPOPROTEIN FROM INSECT HEMOLYMPH. Biochim. biophys. Acta 144, 1 (1967) 117-179.

The diglyceride released from insect fat body was previously found by the authors to be firmly bound to a specific haemolymph protein, to form a "diglyceride-bound lipoprotein". This protein is suggested to be the only possible means by which insects transport long-chain fatty acids from the fat body to the site of utilization. It has now been isolated, using the pupal haemolymph of the silkworm, Philosamia cynthia. (1-^{14}C) palmitic acid (5×10^5 cpm, 0.02 μM) was injected into the pupa. The palmitic acid is first incorporated into the glyceride fraction (mainly tri- and diglyceride) in the fat body, and only then is ^{14}C-diglyceride released rapidly and specifically into the haemolymph (here, $\sim 5 \times 10^4$ cpm of diglyceride for 1 ml of haemolymph). The lipoprotein was subsequently isolated, the steps being described. It is a globulin-like protein. Its precipitation depends not only on the ionic strength but also on the pH, the optimal pH for precipitation being $\sim$6.5. The lipoprotein is deep yellow, the colour representing carotenoid pigment (s). The solubility curve of the lipoprotein strongly suggests that both diglyceride and carotenoid are conjugated to a single protein.

364 Clayton, R.B., Hinkle, P.C., Smith, D.A., Edwards, A.M. THE INTESTINAL ABSORPTION OF CHOLESTEROL, ITS ESTERS AND SOME RELATED STEROLS AND ANALOGUES IN THE ROACH, Eurycotis floridana. Comp. Biochem. Physiol. 11 (1964) 333-350.

Commercially obtained 4-^{14}C-cholesterol, 4-^{14}C-Δ^4-cholesten-3-one, and 7α-^3H-cholesterol of high specific activity were purified and diluted. Other compounds were prepared from them as follows: 7α-^3H-cholestanol via 7α-^3H-cholesteryl acetate by hydrogenation; 7α-^3H-epicholestanol from 7α-^3H-cholesterol via 7α-^3H-cholestanone; 4-^{14}C-Δ^4-cholestenol from 4-^{14}C-Δ^4-cholesten-3-one; 4-^{14}C-Δ^7-cholestenol from 4-^{14}C-cholesterol via 4-^{14}C-7-dehydrocholesterol, 7α-^3H-cholesteryl methyl ether from 7α-^3H-cholesterol; 4-^{14}C-cholesteryl chloride from 4-^{14}C-cholesterol; 3α-^3H-sitosterol from B-sitosterol; and 3α-^3H-sitosterol via its digitonide. Individual insects showed considerable quantitative variability in handling sterols and sterol analogues fed to them. A differential double labelling technique has therefore been generally used, in which cholesterol and another sterol, ester or analogue, each differently labelled with ^3H or ^{14}C, are fed simultaneously to the same animal, the fate of the ingested cholesterol serving as internal standard. Specific activities of 5000 dpm ^{14}C and 20 000 dpm ^3H/mμM were used allowing an accuracy of $\pm$ 5% in

radioassay. Absorption of cholesterol from the intestinal tract of E. floridana was shown to occur predominantly in the crop but probably also in the gastric caeca. The amount absorbed is approx. proportional to the amount of cholesterol ingested over the range 0.05-500 μg. The role of esterification in the intestinal absorption of cholesterol was studied but remains incompletely defined. However, several lines of evidence suggest that esterification is not an obligatory event, though it may facilitate absorption at low dietary concentrations. Evidence is presented for the absorption of intact aliphatic cholesteryl esters from the gut. Cholestanol, cholesteryl methyl ether and cholesteryl chloride are absorbed about as efficiently as cholesterol. Δ^7-cholestenol is absorbed more efficiently, but β-sitosterol, Δ^4-cholestenol and epicholestanol are absorbed less efficiently than cholesterol. These findings are compared with those from similar studies in vertebrates.

365 Crone, H.D. TRIS BUFFER AS AN ETHANOLAMINE COMPETITOR IN THE METABOLISM OF PHOSPHATIDES. Biochem. J. 100, 1 (1966) 12P.

The calcium stimulated incorporation of (2-^{14}C)-ethanolamine and of serine into the phosphatides of the larval fat body of the house fly Musca domestica is being studied. During these investigations it was noticed that the rate of incorporation of ethanolamine was much less in tris (2-amino-2-hydroxymethylpropane-1,3-diol) buffer than in other buffers. Thus under comparable conditions at pH7.4 in 10mM-$CaCl_2$, 17 mM-tris-HCl gave a rate of 6×10^{-9} moles/h/g of larvae, 75 mM-sodium diethylbarbiturate-HCl gave 29×10^{-9} moles/h/g and 42 mM-imidazole-HCl gave a rate of 32×10^{-9} moles/h/g. Using tris buffer, an apparent K_m value for both ethanolamine and serine of 2×10^{-3} M was obtained. The incorporation of ethanolamine at two concentrations of tris buffer (13mM and 112mM) was studied. The graph of the reciprocals of velocity against ethanolamine concentration gave two straight lines intersecting at the 1/v axis, the conditions for competitive inhibition. From this plot values of 1.7×10^{-4} M for the K_m of ethanolamine, and of 1.8×10^{-3} M for the K of tris were obtained. It is apparent that the relatively high concentration of tris is competing with the ethanolamine to depress the rate of incorporation. The apparent K_m value observed for ethanolamine and serine in the tris buffer is therefore largely that of tris. (From abstr.)

366 Crone, H.D. THE CALCIUM-STIMULATED INCORPORATION OF ISOTOPIC SERINE AND ETHANOLAMINE INTO THE PHOSPHOLIPIDS OF HOUSEFLY (Musca domestica) LARVAE. Biochem. J. 102, 1 (1967) 4P-5P. "Proceedings of the Biochemical Society, Slough, England. 12 Nov. 1966".

The incorporation of (2-^{14}C)ethanolamine and L-(3-^{14}C)serine into the phospholipids in homogenates of the fat bodies of larval house flies has been studied. This incorporation is dependent on the calcium ion concentration, maximal rates being obtained at 20 mM in imidazole buffer. Mg will not replace Ca, but is not directly inhibitory. Mn, Zn, and ions at 10 mM completely inhibit incorporation. The pH optimum in veronal buffer lies between 7.25 and 8.25, beyond these points the activity falls off sharply. The incorporation is greatly reduced by 1 mM-cetyltrimethylammonium bromide and by 0.1% Triton X-100. Serine and ethanolamine both have K_m values of 2×10^{-4} M when measured in imidazole buffer with 10 mM calcium. The incorporation of the radioactive serine or ethanolamine is judged to be a direct exchange with existing nitrogenous bases on the phospholipids, rather than a reflexion of net synthesis of the lipids. This is because of the kinetics of the incorporation, which do not favour the presence of intermediates, and because the incorporation is Ca dependent, whereas the incorporation of (^{32}P) phosphorylethanolamine in the same system is stimulated by Mg and not by Ca. In the present work the results are in accord with the presence of one enzymic system exchanging ethanolamine, serine and foreign aminoalcohols with the bases of phospholipids, the precise nature of which has not been elucidated.

367 Crone, H.D. THE CALCIUM-STIMULATED INCORPORATION OF ETHANOLAMINE AND SERINE INTO THE PHOSPHOLIPIDS OF THE HOUSEFLY Musca domestica. Biochem. J. 104, 2 (1967) 695-704.

The Ca-stimulated incorporation of (2-^{14}C)ethanolamine and L-(3-^{14}C)-serine (initial specific radioactivity of 4.86 and 4.6 mCi/mM, respectively) into the phospholipids of homogenates of the fat bodies from larval house flies (M. domestica) was studied. Ethanolamine and serine acted as competitive inhibitors with one another. N-Methylethanolamine was not distinguished from ethanolamine by the system. Tris buffer was also a competitor with these compounds, and a number of other amino alcohols were inhibitory, probably competitively. (^{32}P)Phosphorylethanolamine

(initial specific radioactivity 100 mCi/mM) was prepared from ethanolamine, orthophosphoric acid and (^{32}P)orthophosphate solution. The incorporation of (^{32}P) phosphorylethanolamine into phospholipids was observed in suspensions of whole fat bodies. This incorporation was stimulated by Mg. During the incubation of the homogenates, a Ca-stimulated breakdown of phospholipids by a phospholipase A occurred. These results are compared with results published for similar mammalian systems, and their possible physiological significance is discussed.

368 Crone, H.D. THE RELATIONSHIP BETWEEN PHOSPHATIDE SERINE AND ETHANOLAMINE IN LARVAE OF THE HOUSEFLY, Musca domestica. J. Insect Physiol. 13 (1967) 81-90.

The incorporation of L-(3-^{14}C) serine into the phosphatides of M. domestica larvae was examined in vivo, and of this compound and [2-^{14}C]ethanolamine in vitro, using whole fat body preparations. Rapid incorporation, probably by an exchange reaction, was observed in both cases. Lipid serine was the direct precursor of lipid ethanolamine over the short time periods studied. Ethanolamine depressed the incorporation of serine but the reverse effect was not shown. These results are discussed in relation to current ideas of mammalian phosphatide metabolism. (Auth.)

369 D'Costa, M., Birt, L.M. THE OXIDATION OF FATTY ACIDS BY THORACIC TISSUES DURING THE DEVELOPMENT OF THE BLOWFLY Lucilia cuprina. Biochem. J. 104, 1 (1967) 11P.

Evidence shows that the developing thorax of Lucilia contains a particulate, carnitine-dependent system capable of oxidizing fatty acids, which virtually disappears at maturity. The oxidation of butyrate (25 mM) by a particulate preparation isolated from a filtered homogenate of bisected Lucilia thoraces required a 4-carbon acid (e.g. malate, 0.5 mM) and was stimulated by ATP (2mM). The rates of O_2 uptake, corrected for the endogenous respiration which itself appeared to be due to fatty acid oxidation, were 10-20 µl of O_2/mg protein/h. CoA, carnitine or serum albumin did not increase O_2 uptake; butyryl carnitine was not oxidized more rapidly than butyrate. Palmitate oxidation was stimulated by all these cofactors. There was a considerable dependence on carnitine and the O_2 uptake with palmitylcarnitine (50-80 µl of O_2/mg protein/h) was considerably greater than with any system where palmitate itself was the substrate (10-20 µl of O_2/mg protein/h). The distribution of the active particles during centrifuging in density gradients suggests that the developing sarcosomes themselves are responsible for the oxidation. As judged by $^{14}CO_2$ released from labelled fatty acids, the oxidase system appears about 2.5 d before adult emergence, reaches max. activity at about emergence, then declines to an extremely low level as the fly matures. Freezing and thawing the mitochondria from mature flies did not increase the oxidation which, therefore, does not appear to be limited by sarcosomal impermeability. Thus the oxidase system is active only during the period of adult formation. Its appearance and disappearance enables the fly to energise its thoracic development at the expense of pupal reserves of fat, which are unable to support adult flight. Conversely, the smaller reserves of carbohydrate are conserved to provide the energy for flight after emergence, a process in which carnitine may also be concerned.

370 Dutky, R.C., Robbins, W.E., Shortino, T.J., Kaplanis, J.N., Vroman, H.E. THE CONVERSION OF CHOLESTANONE TO CHOLESTANOL BY THE HOUSEFLY, Musca domestica L. J. Insect Physiol. 13, 10 (1967) 1501-1510.

Larvae of the house fly, M. domestica L., reared aseptically on a semi-defined diet failed to develop when either cholestenone, cholestanone, or cholestanol was used as the sole source of dietary steroid. However, when these three steroids were tested for 'sparing' activity (in combination with a sub-minimal quantity of cholesterol) cholestanone and cholestanol were 66 and 79%, respectively, as effective as an optimum concentration of cholesterol. Under the same conditions cholestenone showed only low biological activity (11%). Biochemical studies with 4-^{14}C-cholestanone indicate that the utilization of this steroid in the house fly larvae proceeds through its partial conversion to cholestanol. The 4-^{14}C-cholestanone used was prepared from 4-^{14}C-cholesterol by hydrogenation to cholestanol. The identity of cholestanol as a metabolite of cholestanone was established by radiotracer techniques, gas-liquid chromatographic analysis, and by isolation of crystalline cholestanol from house fly pupae reared aseptically on a semi-defined diet containing cholestanone plus a subminimal amount of cholesterol. Using reverse isotope dilution techniques, no significant conversion of ^{14}C-cholestanone to cholesterol was detected. In studies with adult insects, both males and females converted injected ^{14}C-cholestanone to cholestanol. (Essentially auth.)

371 Earle, N.W., Walker, A.B., Burks, M.L. STORAGE AND EXCRETION OF STEROIDS IN THE ADULT BOLL WEEVIL. Comp. Biochem. Physiol. 16, 3 (1965) 277-288.

Adult boll weevils (Anthonomus grandis Boh.) required about 20 mg of cholesterol/100 g of diet for sustained egg production and normal longevity. Nutritional and radiotracer experiments indicated a high rate of replacement of body cholesterol. The mean lifespan for adult weevils on sterol-deficient diets was 14 d as compared with the normal range of 55-89 d for laboratory-reared weevils. Sterol-deficient females laid almost no eggs. Significant amounts of sterol were carried over from the larval to the adult stage. A high percentage of the cholesterol in newly emerged adults was replaced within 15 d by 4-^{14}C-cholesterol given in the diet. Fat weevils contained more sterol esters than lean weevils, but about the same quantity of free sterols. (Auth.)

372 Eldefrawi, M.E., O'Brien, R.D. PERMEABILITY OF THE ABDOMINAL NERVE CORD OF THE AMERICAN COCKROACH TO FATTY ACIDS. J. Insect Physiol. 12 (1966) 1133-1142.

The following 1-^{14}C-labelled fatty acids were used in the study: acetic, propionic, butyric, valeric, hexanoic, heptanoic, and octanoic acid. The rates of influx of ^{14}C-labelled fatty acids into the abdominal nerve cord of the cockroach Periplaneta americana L. are directly correlated with their octanol/water partition coefficients. Low temperature and exposure to 2,4-dinitrophenol decrease the rate of influx slightly. It is suggested that influx of the acids into the abdominal nerve cord is due to simple diffusion facilitated by the acid's high lipid solubility and the involvement of these acids in the normal metabolism of nerve tissue. Efflux of these acids is characterized by a two-stage process with simultaneous rapid and slow phases. The fast phase is 30 times faster than the slow one. It is suggested that the rapid phase involves the efflux of a pool confined to the extracellular spaces, whereas the slow efflux is that of acids from intracellular spaces within the perineurium. The nerve sheath offers a resistance to efflux of the anions of about 13 times that which it offers to glucose. However, a much larger barrier is offered by the neuronal and glial cell membranes that regulate the movement of these acids within the cord.

373 Gilbert, L.I. LIPID METABOLISM AND FUNCTION IN INSECTS. p. 69-211 of "Advances in Insect Physiology. Vol.4". London, Academic Press, 1967, 415p.

Very comprehensive review of the field. A classification of lipids is given, and the lipid content of various insect species tabulated in terms of stage and % lipid. Alterations during metamorphosis, and the nature of insect lipids is discussed. The remaining article is divided into sections on lipid utilization (digestion and absorption, lipid release and transport, extra-digestive lipases, fatty acid catabolism); lipid biosynthesis (general mechanism of fatty acid synthesis, fatty acid biosynthesis in insects, phospholipid and triglyceride, fatty acids in nutrition, substrate interconversion); hydrocarbons and waxes (cuticle, and extra-cuticular); and isoprenoid compounds (nutritional studies, isoprenoid biosynthesis content, sterol modification, function, and insect hormones). - Throughout the text, a large number of supporting studies are quoted in which radioisotopes have been used (which are also mentioned specifically). Some unpublished observations by the author, based on radioisotope studies, are cited in the text. - An extensive bibliography is appended.

374 Gilbert, L.I. CHANGES IN LIPID CONTENT DURING THE REPRODUCTIVE CYCLE OF Leucophaea maderae AND EFFECTS OF THE JUVENILE HORMONE ON LIPID METABOLISM IN VITRO.

Lipid is stored in both the ovaries and fat body of female L. maderae during the 20 d period of oogenesis and is a major substrate for the developing embryos during the ensuing two months of embryogenesis. The lipid picture for the period of embryogenesis is characterized by a decreasing content of embryonic triglyceride and an increasing proportion of phospholipid. Both the fat body and ovaries (maturing oocytes) are capable of incorporating labelled palmitate into glyceride and phospholipid. In vitro studies demonstrated the transfer of labelled lipid from the fat body of ovaries and it is likely that this takes place in vivo as well. The metabolic activity of the fat body is influenced by the stage of the reproductive cycle, particularly in reference to lipid metabolism. In vitro studies with active corpora allata suggest that one reason the juvenile (gonadotropic) hormone is indispensable for oocyte maturation is its ability to enhance lipid synthesis in the ovary (maturing oocytes) during oogenesis. These studies suggest that the juvenile hormone may act to depress the lipid synthetic ability of the fat body at this stage and thus make more substrate available to the developing oocytes. (CA 66: 1967, 113448h)

375 Goodfellow, R.D. THE BIOCHEMISTRY AND METABOLISM OF STEROLS AND ISOPRENOIDS IN THE METAMORPHOSIS OF THE AMERICAN SILKMOTH, Hyalophora cecropia (L.). Diss. Abstr. 27 (1966) 2543-B - 2544-B.

The metabolism of sterols was analysed by using radioactive mevalonic acid, plant sterols, and cholesterol. Cholesterol, β-sitosterol, and campesterol were identified as the sterols of Cecropia during metamorphosis. Cholesterol is the major sterol at all stages of the life history investigated in this study. The quantity of cholesterol increases from the larva to the adult with a concomitant decrease in the relative amount of the other sterols. This increase continues in the male until senility but there is a marked decrease in the cholesterol level of the female after oviposition. Cholesterol is the major sterol of the eggs. There is no significant biosynthesis of cholesterol or squalene from ^{14}C-mevalonate. Box elder leaves, the food plant of H. cecropia, contain no cholesterol. They do contain campesterol and β-sitosterol, and thus supply the organism with these plant sterols. It was determined that Cecropia dealkylates the plant sterols to produce cholesterol. This conversion process is active at all stages of the life cycle. A small amount of sterol in Cecropia is esterified with preponderantly unsaturated long-chain fatty acids. The quantity of unsaturated fatty acids as esters of cholesterol is higher than the quantity of these same fatty acids in the neutral lipid of this organism. The utilization of cholesterol in Cecropia was determined by tracing the metabolic fate of injected cholesterol-4-^{14}C. The greater part of this cholesterol remains unchanged. The major portion of the free cholesterol in the thoracic muscle was associated with cellular membranes and other particulate fractions. The role of cholesterol in thoracic muscle was interpreted to mean a utilization of cholesterol as a unit of the cellular membranes of all cells of this organism. Support for the role of cholesterol as a unit of cell structure is suggested, also, by the constant quantity of sterol throughout the pupal-adult transformation. Large amounts of free sterol were also associated with the nervous system. This cholesterol may be associated with myelin membranes. The "polar steroids" of Cecropia derived from cholesterol are an index of the oxidative metabolism of steroids. "Polar steroids" are ubiquitous in Cecropia, with a higher concentration of "polar steroids" in the intestine and lumen contents. Also many of these "polar steroids" may be metabolites in the production of insect hormones like ecdysone, ecdysone itself, of other steroidal hormones of unidentified nature. None of these categories of "polar steroids" in Cecropia are mutually exclusive and all may form a part of the "polar steroid" pool of metamorphosing animals. 98% of the cholesterol and "polar steroids" in the haemolymph are bound to protein. The higher levels of cholesterol in the haemolymph than the tissues suggests mobilization of sterol as a part of adult development. The high titers of cholesterol in the haemolymph are cogent evidence against the role of cholesterol as the active principle of the prothoracic gland stimulating hormone. The binding of "polar steroids" to specific haemolymph protein acceptors may be involved in hormone transport. Other isoprenoids do occur in Cecropia and the major are trans-nerolidol, trans-trans farnesol, geraniol and the 20 carbon analogues of nerolidol. Their quantitative changes during pupal-adult transformation are not great enough to account for the increase in juvenile hormone activity in the adult male moth. Experiments in which the corpora allata, the source of the juvenile hormone, were extirpated demonstrated no significant difference in the isoprenols in these moths and those of normal moths. The column chromatographic fraction containing these compounds incorporated 75% of the count of mevalonate-^{14}C in the non-saponifiable lipid. Very small amounts of pyrophosphate esters of these compounds were found in Cecropia lipids. The low levels of the pyrophosphate compounds may be due to in vivo dephosphorylating enzyme systems. Also, extremely small amounts of ^{14}C label were associated with the acids of Cecropia lipids but these were not identified as any of the isoprenoic acids found in other organisms. (From DA)

376 Happ, G.M., Meinwald, J. BIOSYNTHESIS OF MONOTERPENES IN AN ANT. Adv. Chem. Ser. 53 (1966) 27-33.

Terpenoid substances are of broad distribution and diverse function in insects. One set, elaborated by the mandibular glands of Acanthomyops claviger, acts both as a defensive secretion and as an alarm releaser. When fed ^{14}C-labelled acetate or mevalonate, laboratory colonies of these ants produce radioactive citronellal and citral, providing unambiguous evidence for de novo synthesis of these terpenes by the ant. The incorporations of these precursors implicate the mevalonic acid pathway as the likely biosynthetic route. (CA 65: 1966, 5935h)

377 Ikekawa, N., Suzaki, M., Kobayashi, M., Tsuda, K. STEROLS OF Bombyx mori. IV. STEROL CONVERSION IN THE SILKWORM. Chem. pharm. Bull., Tokyo 14, 8 (1966) 834-836.

Dietary β-sitosterol-^{3}H was incorporated by B. mori larvae into cholesterol. Radioactivity was also incorporated into the cholesterol of the free fraction, but was not found in the sterol ester fraction, in the pupa. Larval cholesterol therefore originates from the β-sitosterol of the mulberry leaf, and sterol metabolism in the pupa differs from that in the larva. (CA 65: 1966, 17437b)

378 Keith, A.D. FATTY ACID METABOLISM IN D. melanogaster: FORMATION OF PALMITOLEATE. Life Sci. 6, 2, Pt.2 (1967) 213-218.

The presence of dietary linoleate (I) drastically altered the relative proportions of palmitate (II) and palmitoleate (III) in D. melanogaster. The addition of dietary II in the presence of dietary I only slightly elevated the relative proportion of III. Therefore, I prevented the enzymic desaturation of II. The uptake of labelled acetate into III was relatively unchanged by dietary I, although the uptake of label into II was somewhat reduced. The extent to which II-^{14}C was desaturated, however, was highly dependent on dietary I. The presence of I almost completely inhibited the desaturation of II. When both acetate-^{3}H and II-1-^{14}C were added simultaneously in the normal diet, ^{3}H from acetate and ^{14}C from II were both found in III in about the same proportions. Simultaneous labelling in the presence of I resulted in the incorporation of labelled II, but only 2.45% of II was converted into III, while the label from acetate which appeared in III was undisturbed. Therefore, D. melanogaster has two ways of producing III: a de novo route which is undisturbed by dietary I, and the direct desaturation of pre-existing II which is inhibited by dietary I. (CA 66: 1967, 62940c)

379 Keith, A.D., Gauslaa, G., Anderson, B.S. IN VITRO BIOSYNTHESIS OF FATTY ACIDS IN Drosophila melanogaster. Lipids 2, 5 (1967) 429-431.

A new in vitro technique, utilizing ruptured larvae of D. melanogaster, was employed to study the incorporation of acetate-^{3}H into long-chain fatty acids. Preparative gas-liquid chromatography and scintillation spectroscopy were used to determine the relative activity of each fatty acid from total lipid extracts. Quantitative changes were observed in the distribution of label during the course of the incubation times, which ranged from 5 min to 9 h. All fatty acids which incorporated acetate in previous in vivo studies also showed incorporation of label under these in vitro conditions. It is concluded that this system may be useful for studying aspects of insect metabolism for short intervals of time. (CA 67: 1967, 88627b)

380 Khan, M.A.Q., Hodgson, E. PHOSPHOLIPIDS OF SUBCELLULAR FRACTIONS FROM THE HOUSEFLY, Musca domestica L. J. Insect Physiol. 13 (1967) 653-664.

The phospholipids of subcellular fractions from the house fly, Musca domestica L., were studied. In the first series of experiments adult flies were fed on sucrose cubes and water for 2 d after emergence. In the second series, 1 mCi of $H_3{}^{32}PO_4$ was added to the water. The analyses show that there are variations in the distribution of some phospholipids among these fractions. The most unusual is the microsomal fraction which contains only 36% phosphatidylethanolamine whereas the other fractions contain 50 to 59% of this phosphatide. The microsomal fraction also differs from other fractions in its higher content of phosphatidylcholine, lysophosphatidylethanolamine, and ethanolamine sphingolipid. Mitochondria contain 5% cardiolipin, whereas the microsome and residue fractions contain 4 and 3% respectively. The supernatant fraction contains only 7% of the total phospholipids, most of this being in the form of phosphatidylethanolamine.

381 Kinsella, J.E., Smyth, T. LIPID METABOLISM OF Periplaneta americana L. DURING EMBRYOGENESIS. Comp. Biochem. Physiol. 17, 1 (1966) 237-244.

The weight of the oothecae of the P. americana decreased by 25% during embryogenesis; 17% of this was due to water loss and the remainder was due to lipid catabolism. Chromatographic analysis revealed that a decrease in the neutral lipids, exclusively the triglyceride fraction, accounted for the major loss in dry matter of the eggs. A sharp increase in monoglycerides and diglycerides during nymphal emergence indicated that intense hydrolysis of triglycerides was occurring. The very high neutral lipid content of the ootheca is consistent with its function of energy storage in the egg. Thus, the American cockroach, like other oviparous animals, metabolise lipid material as its principal source of respiratory energy. (CA 64: 1966, 11606h)

382 Lasser, N.L. THE FUNCTION OF STEROLS IN INSECTS. Diss. Abstr. 27, 6 (1966) 1781-B-1782-B.

In the hide beetle, Dermestes vulpinus, over 90% of the cholesterol supplement can be replaced by a sparing sterol. The present work was undertaken to investigate possible sterol transformations in Dermestes and to extend the studies of Clayton on intracellular sterol distribution and sterol turnover in Eurycotis. It was found by gas chromatographic analysis that neither cholesterol nor eight other sterols undergo any appreciable molecular transformation in Dermestes. The beetle does, however, selectively concentrate cholesterol from a diet also containing large amounts of sparing sterol; the degree of this selectivity varies with the nature of the sparing sterol. The histological effects of sterol deprivation were studied in Eurycotis. The effects, seen in every tissue, are non-specific and could be related to aging. The distribution and turnover of radioactive sterols were studied in aseptic Eurycotis reared from time of hatching on 0.005% cholesterol-^{14}C and 0.1% cholestanol-^{3}H. Cholestanol is in part converted to Δ^7-cholestenol. The studies with whole tissue of Eurycotis showed that cholesterol is preferentially accumulated in most tissues and remains almost entirely unesterified. On the other hand, sparing sterols are esterified to a varying degree. The proportion of Δ^7-cholestenol found also varies from tissue to tissue. In fat body it constitutes over 80% of the esterified sterol, but no other pattern suggestive of definite functional significance is discernible. Cholesterol is displaced slowly if at all in most tissues, while non-esterified cholestanol turns over at a considerably greater rate. The displacement is accompanied by a shift of sterols from the unesterified to the esterified pool and from other tissues to the fat body, where much of the ester formed is apparently stored during growth. In insects grown on a diet containing both cholesterol and cholestanol intracellular sterol distribution was examined by autoradiography and subcellular fractionation. The fractions were characterized by their light and electron microscopic appearance and by their content of DNA, RNA, protein, succinic dehydrogenase, and lipid phosphorus. Autoradiography shows both sterols to be primarily cytoplasmic and in some instances localized in membranous structures. Satisfactory subcellular fractions were obtained from muscle, nerve, and salivary gland. Free sterol is found primarily in mitochondria and microsomes, the fractions also richest in sterol per mg. of protein. Sterol ester is apparently distributed randomly but probably originates from the depot fat in all the tissues. The free sterols are present in a relatively constant ratio to each other throughout the cell. A purified nuclear preparation from salivary gland contains 5% of the cell's free sterol, and all the free sterol of microsomes is in the membranous portion prepared by RNAase treatment. It is concluded that free sterols are incorporated as components of all the cellular membrane systems in insect tissues. There are probably at least two functionally characteristic spaces common to all membranes, one space being structurally more specific and more inert than the other. Sterol ratios, constant in a single tissue, vary among the different tissues, and the variation may reflect functional differences among the membranes of these tissues. (From DA)

383 Lasser, N.L., Edwards, A.M., Clayton, R.B. DISTRIBUTION AND DYNAMIC STATE OF STEROLS AND STEROIDS IN THE TISSUES OF AN INSECT, THE ROACH Eurycotis floridana. J. Lipid Res. 7, 3 (1966) 403-412.

The insects were reared aseptically from the time of hatching on a semi-synthetic diet containing sterols of known activity. The diets contained either an optimal concentration (0.1%) of cholesterol-4-^{14}C as the sole sterol, or a minimal concentration of 0.005% cholesterol-4-^{14}C supplemented with 0.1% cholestanol-7α-^{3}H. Other radioactive sterols used were cholesterol-26-^{14}C, cholesterol-3α-^{3}H and cholesterol-7α-^{3}H. In some experiments the insects received the same diet throughout the experimental period; in others they were given a diet containing a different sterol or combination of sterols during a later phase of the experiment. Data are presented in tabulated form on 1) concentration of steroids in tissues of E. floridana reared on diets containing different concentrations of cholesterol; 2) chromatographic fractionation of steroids in tissues of roach reared on diets containing different sterols; 3) displacement of cholesterol from tissues by cholestanol; 4) turnover of steroids in tissues during growth while receiving a diet containing 0.005% cholesterol and 0.1% cholestanol; 5) tissue steroid turnover on a diet containing 5% cholesterol. When the insect was reared on the mixed sterol diet, the cholesterol became concentrated in most tissues in preference to cholestanol. The extent of this preferential incorporation of cholesterol varies from tissue to tissue but is most marked in the nerve, where the two sterols are present in approx. equal amounts. The sum of the concentration of ^{14}C- and ^{3}H-labelled sterols found in almost all the tissues of animals fed the mixed sterol diet is remarkably close to that found in animals reared on 0.1% cholesterol alone. The concentrations of sterols found in the tissues of E. floridana are generally

higher than reported for Periplaneta americana. Cholesterol would appear to fulfil similar functions in both mammalian and insect tissues.

384 Deleted.

385 Mayer, R.J., Candy, D.J. CHANGES IN HEMOLYMPH LIPOPROTEINS DURING LOCUST FLIGHT. Nature, Lond. 215 (1967) 987.

Electrophoresis of haemolymph from resting locusts and from those flown for 2 h was carried out on cellulose acetate using 0.05M Na glycinate buffer at pH 9.8. In the resting haemolymph, 2 of the 8 bands contained lipid; after being flown for 2 h, 4 bands contained lipid and the total lipid content was increased 2.5-fold. Experiments were also carried out with palmitate-^{14}C. A 3-fold increase in lipids was found and thin-layer chromatograph showed that the increase was almost entirely in the diglyceride fraction, the triglycerides remaining essentially constant. (CA 67: 1967, 114625w)

386 Mehendale, H.M., Dauterman, W.C., Hodgson, E. PHOSPHATIDYL CARNITINE: A POSSIBLE INTERMEDIATE IN THE BIOSYNTHESIS OF PHOSPHATIDYL β-METHYLCHOLINE IN Phormia regina (Meigen). Nature, Lond. 211 (1966) 759-761.

Carnitine can replace dietary choline when P. regina larvae are reared on a chemically defined diet, when β-methylcholine almost complete replaces choline in the lecithin of the larva. Carnitine labelled with ^{14}C in the methyl groups was used. P. regina larvae were grown in axenic culture on a chemically defined diet. Chromatograms of the hydrolysate of the whole lipid extract of larvae fed ^{14}C-DL-carnitine showed only 1 radioactive spot corresponding to β-methylcholine. When ^{14}C-carnitine and TMAA (trimethyl-(3-hydroxypropyl) ammonium acetate) are fed, however, two radioactive compounds, β-methylcholine and carnitine, can be found. Carnitine appears to be incorporated into a lipid-soluble compound before decarboxylation to the β-methylcholine of phosphatidyl β-methylcholine, the compound apparently being phosphatidyl carnitine. The inhibitor, TMAA, causes this lipid-soluble carnitine derivative to accumulate to the point where detection is possible. The fact that TMAA is incorporated into a phospholipid may be of importance in elucidating the mechanism of its inhibitory action.

387 Mehrotra, K.N., Sethi, G.R., Bhamburkar, M.W. PHOSPHOLIPIDS IN THE HEMOLYMPH OF DESERT LOCUST, Schistocerca gregaria. Indian J. Ent. 28, 4 (1966) 468-476.

The presence of phospholipids in the haemolymph of the desert locust, S. gregaria, was demonstrated by using ^{32}P labelling and thin-layer chromatography. The phospholipid concentration was 1.8 mg/ml. The results of chromatographic separation and of various hydrolyses performed on different fractions indicated that phosphatidylcholine (40%) was most abundant, that the ratio of phosphatidylethanolamine to phosphatidylcholine was 1:3, and that sphingomyelin was present. It was possible to differentiate insects into three major types depending on their phospholipid composition: insects in which phosphatidylethanolamine is the major phospholipid (house flies and blowflies); insects in which phosphatidylcholine is the major phospholipid (S. gregaria, Periplaneta americana, and Blattella germanica); and insects in which sphingomyelin is present (A(edes) aegypti and S. gregaria). Faster phospholipid turnover has been implicated in the house fly resistance to dieldrin. High phospholipid turnover may reflect a modification in membrane permeability in resistant strains. (CA 67: 1967, 114623u).

388 Meinwald, J., Happ, G.M., Labows, J., Eisner, T. CYCLOPENTANOID TERPENE BIOSYNTHESIS IN A PHASMID INSECT AND IN CATMINT. Science, N.Y. 151 (1966) 79-80.

The stick insect, Anisomorpha buprestoides, and the catmint, Nepeta cataria, produce closely related cyclopentanoid terpenes, anisomorphal and nepetalactone. Tracer experiments with isotopes* indicate that anisomorphal is synthesised by the walking stick from normal terpene precursors (acetate or mevalonate). In the catmint plant, isolated leaf disks synthesised nepetalactone, utilizing the same precursors. (Auth.)

* ^{14}C-mevalonate and sodium acetate-2-^{14}C.

389 Mezei, C., Newburgh, R.W. THE FORMATION OF LIPID-BOUND CARNITINE DERIVATIVES IN THE FAT BODY OF Phormia regina. J. Insect Physiol. 13, 9 (1967) 1489-1499.

DL-(Methyl-^{14}C)-carnitine, DL-(carboxy-^{14}C)-carnitine, (1,2,-^{14}C)-choline were obtained from Tracerlab; DL-(methyl-^{14}C)-palmityl-carnitine and DL-(N-methyl-^{14}C)-β-methylcholine chloride were synthesised, using (^{14}C)-methyliodide in the case of the chloride. Carnitine is incorporated into a phosphatide as β-methylcholine in several insects. The object of this investigation was to further elucidate the mechanism involved. Cell-free fat-body preparations of P. regina larvae catalyse the formation of acyl-carnitines, and this reaction is inhibited by CoA, γ-butyrobetaine, and trimethylamino-propane-1-ol. A minor lipid component was also isolated and this behaved in several tests similar to a phosphatide. In vivo the major carnitine derivative is phosphatidyl-methylcholine whereas in vitro preparations of fat body favour enzymic pathways leading to the formation of long-chain acyl-carnitine derivatives.

OMISSION. Reference should here be made to 466, erroneously listed in the wrong context.

466 Monroe, R. E., Hopkins, T.L., Valder, S.A. METABOLISM AND UTILIZATION OF CHOLESTEROL-4-C^{14} FOR GROWTH AND REPRODUCTION OF ASEPTICALLY REARED HOUSEFLIES, Musca domestia L.

390 Przelecka, A., Dutkowski, A. AUTORADIOGRAPHIC INVESTIGATION OF INCORPORATION OF FATTY ACIDS INTO THE LIPIDS OF INSECT OVARIOLES. Bull. Acad. pol. Sci. Cl. II Sér. Sci. biol. 13, 10 (1965) 573-575.

Isolated ovaries of Galleria mellonella and of Carausius morosus were incubated at 30°C in insect physiological saline supplemented with sodium ^{14}C-palmitate (5 μCi/0.21 μM/ml) for 30 min. Fixation and embedding procedures are described. Lipids were extracted in some experiments. It would appear that the radioactivity detected in the follicular vesicles was not due to labelled free palmitate but to lipids into which the fatty acid had been incorporated. The presence of ^{14}C was demonstrated not only in free fatty acids but also in mono-, di-, and tri-glycerides in cholesterol esters and in some unidentified compounds, detected approximately at the cholesterol level. The presence of ^{14}C was detected in lysolecithin, lecithin, ethanolamine phosphatides and in phosphatidic acids. Tissue autoradiography may allow the detection of biosynthesis of lipids from fatty acids as precursors and localization of the newly formed lipids within the cell.

391 Przelecka, A. INCORPORATION OF 14-C-SODIUM PALMITATE INTO LIPIDS AND CELL INTERACTION IN OVARIOLES OF Galleria mellonella (LEPIDOPTERA). Ann. Histochim. 11, 4 (1966) 403-411. (In English)

Incorporation of ^{14}C-sodium palmitate into lipids followed by means of autoradiography has been found to occur in the follicular vesicle of G. mellonella, chiefly in the trophic cells. These cells seem to provide the oocyte with newly synthesised lipids. The follicular epithelium cells appear to be more active in this process than the trophocytes. (Auth. summary)

392 Rajalakshmi, S.S., Sarma, D.S.R., Sarma, P.S. CHOLESTERIN METABOLISM IN Corcyra cephalonica. Indian J. exp. Biol. 1 (1963) 186-189.

It is known that all insects depend on an exogenous supply of sterin. In the case of C. cephalonica, growth of larval tissue is inhibited when γ-hexachlorocyclohexane (I) is added, together with an enrichment in cholesterin (II). Experiments were carried out with compounds known to reduce the cholesterin content in higher organisms. Nicotinic acid, nicotinamide, sitosterin, stigmasterin, ^{14}C-ergosterin, and rice-bran oil were tested. In experiments to raise eggs of the insect on wheat flour ^{14}C-sodium acetate or $^{14}C_2$-mevalonic acid were added, to elucidate whether larval tissue was able to synthesise II. The results indicate that the effect due to I can only be caused by meso-inosit but not by any of the other compounds tested. The inability of larval tissue to synthesise II was demonstrated but ergosterine was seen to be transformed to II. The structural similarity (metabolite, antimetabolite) between inosit and I is discussed on hand of the supporting literature.

393 Ritter, F.J., Wientjens, W.H.J.M. STEROL METABOLISM OF INSECTS. T.N.O. Nieuws 22, 10 (1967) 381-392.

A review is given of the present knowledge of sterol metabolism in insects including sterol requirements, biosynthesis of Δ^7 sterols, the occurrence of ecdysone and other steroid hormones, in plants, and use of the knowledge of sterol metabolism in developing selective insecticides. Results of unreported exper-

iments are given on the conversion of C_{28} and C_{29} sterols into C_{27} sterols by Blattella germanica. (CA 68: 1968, 66735d)

394 Robbins, W.E., Thompson, M.J., Kaplanis, J.N., Shortino, T.J. CONVERSION OF CHOLESTEROL TO 7-DEHYDROCHOLESTEROL IN ASEPTICALLY REARED GERMAN COCKROACHES. Steroids 4 (1964) 635-644.

Blattella germanica were maintained aseptically on a semidefined diet containing 0.1% of 4-^{14}C-cholesterol for periods of from 36-56 d. The cholesterol used in the diet had a specific activity of 2.08×10^5cpm and a radiochemical purity of 99%. The previously reported conversion of cholesterol to 7-dehydrocholesterol by non-aseptically reared German cockroaches has been confirmed using aseptically reared insects. The identity of the 7-dehydrocholesterol was established by u.v. and infrared spectroscopy and gas-liquid chromatographic analyses of the free sterol and/or derivatives. This metabolic pathway for cholesterol in the German cockroach is discussed.

395 Saito-Suzuki, M., Ikekawa, N., Kobayashi, M. STUDIES ON THE STEROL OF Bombyx mori L. III. FAT AND DISTRIBUTION OF 4-^{14}C-CHOLESTEROL IN THE SILKWORM. Appl. Ent. Zool. 1, 1 (1966) 37-40.

The present study was carried out to elucidate a contribution of the pupal brain to sterol metabolism, observing the fate and the distribution of 4-^{14}C-cholesterol* in both normal and dauer pupae of the silkworm, B. mori. After the injection of labelled cholesterol into the normal and the dauer pupae, the blood, several tissues, and remainder were dissected out from these pupae on 1 d after injection, 7 d and 1 d before emergence. Methanol extract was refluxed with ether, following each sample's extraction with methanol. The radioactivity of both the sterol ester and the free sterol fractions separated from the ether extract was counted. The incorporation of the labelled cholesterol into several tissues and the blood did not show any remarkable difference between the normal and the dauer pupae. In the former, however, a large amount of cholesterol was demonstrated as ester form, while in the latter, free sterol was observed. Furthermore, the rate of esterification in dauer pupa sterol was slower than that of normal pupa, suggesting that unknown factor originating from brain had an intimate relation to sterol metabolism. (Auth.)

*1 μCi (15.7 μg) dissolved in 0.015 ml of olive oil.

396 Schmidt, G.H. THE BIOCHEMISTRY OF INSECT STEROLS AND REVIEW OF LITERATURE. Fette, Seifen, Anstr.-Mittel 68, 10 (1966) 811-816. (In German)

Not all arthropods are able to synthesise sterines from C_2-elements. On the other hand, insect cells contain cholesterin as structural element, associated with phospholipid-protein complexes. Sterines are essential for normal growth. The article reviews insect sterines, sterines in nutrition and their utilization, sterine requirements, sterine deposits stored in adipose tissue, the biosynthesis of sterines, sterines in metabolism, steroid hormones, and immunophysiological effects. Radioisotopes had been used in a considerable number of the studies cited.

397 Sridhara, S., Ravi Rao, U., Bhat, J.V. METABOLISM OF SATURATED 1-^{14}C-LABELLED FATTY ACIDS IN THE SILKWORM, Bombyx mori. Biochem. J. 98, 1 (1966) 260-265.

Only a small percentage of 1-^{14}C-labelled saturated fatty acids injected in the silkworm is respired as CO_2. The rate of utilization of fatty acids is low both at the larval and pupal stages. The insect has the ability to elongate C_{12} and C_{16} saturated fatty acids and to desaturate C_{18} saturated fatty acids. Much of the administered radioactivity is found in the triglyceride fraction, followed by the phospholipid and diglyceride fractions. Diglycerides seem to be the transport form of fatty acids. The insect seems to handle both natural and unnatural fatty acids in the same manner. (CA 64: 1966, 8686c)

398 Sun, G.Y.C. NEUTRAL LIPID METABOLISM IN THE FAT BODY OF THE LARVA OF THE FLESHFLY, Sarcophaga bullata. Diss. Abstr. 28, 2 (1967) 483-B – 484-B.

The weight of the larva, the fat body as well as its lipid content were examined in relationship to the growth of the larva. The average larva attained max. body weight of about 220 mg in 70 h. Fat body lipid continued to increase in weight after the feeding stage of the larva during which time there

was a small decrease in total larval wet weight. The fat body lipid comprised mainly of the neutral lipid and triglyceride formed the major portion of the neutral lipid. Approx. 60% of the total fatty acids analysed was found to be unsaturated and an increase in unsaturated fatty acid content was found in the fat body of the 9-d-old larvae. The major portion of fatty acids in the fat body as analysed by gas liquid chromatography were palmitic, palmitoleic, stearic, oleic and linoleic acids. A very small amount of acetate-1-^{14}C was incorporated into the fat body lipid. Palmitate-1-^{14}C, on the other hand, was more extensively incorporated. Most of the radioactivity which was incorporated into the neutral lipid was present in the three glyceride fractions, of which the diglycerides showed the highest specific activity. It is suggested that diglyceride could play an important role in lipid transport in the insect system. A very rapid uptake of palmitate-1-^{14}C into fat body was observed in the first 30 min of incubation. Comparison of palmitate-1-^{14}C incorporation between the 3-d- and 7-d-old larvae showed that larvae at their prepupal stage were still able to incorporate long-chain fatty acids but to a somewhat lesser extent. Fatty acids of neutral lipid were separated into saturated and unsaturated components on thin-layer plates. After incubation of fat body of 3-d-old larvae with palmitate-1-^{14}C, the ratio of the distribution of the label between unsaturated and saturated fat was ~60-40, achieved within 10 min of incubation. In 7-d-old larvae, most of the label was found in the saturated fraction. (Based on DA)

399 Svoboda, J.A., Thompson, M.J., Robbins, W.E. DESMOSTEROL, AN INTERMEDIATE IN DEALKYLATION OF β-SITOSTEROL IN THE TOBACCO HORNWORM. Life Sci. 6, 4 (1967) 395-404.

β-Sitosterol-^{3}H fed to tobacco hornworm (Manduca sexta) was converted to desmosterol (cholesta-5,24-dien-3β-ol) (I) and desmosterol acetate. Even when the digestive tract was bypassed by injecting β-sitosterol into the anal horn, considerable dealkylation occurred. M. sexta also metabolised 90% of the ^{14}C-labelled I administered in the diet to cholesterol (II), but none of the II administered via the diet could be metabolised to I. It appears that I must be the terminal intermediate in dealkylation before the formation of II in M. sexta. (CA 66: 1967, 74638m)

400 Svoboda, J.A., Robbins, W.E. CONVERSION OF BETA SITOSTEROL TO CHOLESTEROL BLOCKED IN AN INSECT BY HYPOCHOLESTEROLEMIC AGENTS. Science, N.Y. 156 (1967) 1637-1638.

Two vertebrate hypocholesterolemic agents (triparanol and 22,25-diazacholesterol) block the conversion of β-sitosterol to cholesterol in the larva of the tobacco hornworm, Manduca sexta (Johannson). A primary site of inhibitory action is the terminal step in this conversion – the reduction of desmosterol (24-dehydrocholesterol) to cholesterol. * This is also the site at which these compounds inhibit de novo cholesterol biosynthesis in higher animals. Both agents severely inhibit growth and maturation of the tobacco hornworm. (Auth.)

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* The Δ^{24}-sterol reductase in gut tissue normally converts ^{14}C-desmosterol to ^{14}C-cholesterol.

401 Thomas, K.K., Gilbert, L.I. IN VITRO STUDIES ON THE RELEASE AND TRANSPORT OF PHOSPHOLIPIDS. J. Insect Physiol. 13, 6 (1967) 963-980.

When incubated in vitro, fat body from several developmental stages of the silkmoth, Hyalophora cecropia, and from the cockroaches, Leucophaea maderae and Periplaneta americana, has the ability to incorporate labelled precursors into phospholipid. Palmitate-1-^{14}C as the Na salt, albumin complex, or ethanolamine-^{14}C, glycerol-^{14}C, or ^{32}P-disodium phosphate were used as labelled substrates. When this 'prelabelled fat body' is reincubated in unlabelled medium containing haemolymph, radioactive phospholipids are released into the incubation medium. Flight muscle placed into an incubation medium containing radioactive phospholipids is capable of incorporating some of this phospholipid into flight muscle phospholipid. The majority of the labelled phospholipid released from the prelabelled fat body consists of phosphatidylcholine, phosphatidylethanolamine, and phosphatidylserine. Electrophoretic analysis of the haemolymph containing incubation medium revealed that phospholipids released from the fat body were conjugated to specific haemolymph proteins. One of these lipoproteins is thought to be analogous to the high-density lipoproteins of mammalian blood. In vivo labelling of the fat body was effected by injecting ^{32}P-disodium phosphate. The release of phospholipids from the fat body was similar to the results obtained in vitro. The study suggests that insect fat body has the capacity to synthesise phospholipids from simple precursors and release this phospholipid into the haemolymph from where it is transported in the form of lipoprotein.

402 Thomas, K.K., Gilbert, L.I. PHOSPHOLIPID SYNTHESIS DURING FLIGHT MUSCLE DEVELOPMENT IN THE AMERICAN SILKMOTH, Hyalophora cecropia. Comp. Biochem. Physiol. 21, 2 (1967) 279-290.

The major phospholipid fractions of the flight muscle and sarcosomes are phosphatidylcholine and phosphatidylethanolamine. The cardiolipin fraction increases from 1.3 - 11.8% of the lipid P of the flight muscle during muscle maturation. Unsaturated fatty acids predominate in the various flight muscle phospholipids with linolenic acid comprising about 70% of the total fatty acids in the cardiolipin fraction. The phospholipid composition of the moth sarcosomes more closely approximates that of beef heart mitochondria than that of house fly flight muscle sarcosomes. Radioisotope and chemical studies indicate the synthesis of phospholipids during adult development of H. cecropia. (CA 66: 1967, 113416w)

403 Tietz, A. FAT SYNTHESIS IN CELL-FREE PREPARATIONS OF THE LOCUST FAT-BODY. J. Lipid Res. 2, 2 (1961) 182-187.

It was shown that cell-free preparations of the fat body of the migratory locust, Locusta migratoria, incorporated acetate into fatty acids in the presence of ATP, CoA, glutathione, Mg^{++}, TPN, malonate, α-ketoglutarate, and $KHCO_3$. The major fatty acid component synthesised was palmitic acid. The newly synthesised acids were esterified by the system with glycerol as glycerides and phospholipids. Mitochondria were not required for synthesis. Fat body homogenates could also activate and decarboxylate malonate and form malonic acid by CO_2 fixation. In the enzymatic assays, acetate-1-^{14}C was used (incubated with cofactors and enzyme). At a later state, the decarboxylation of malonate-1-^{14}C and malonate-2-^{14}C was measured. To determine optimal conditions for fatty acid synthesis from acetate by fat body homogenates the latter were incubated with acetate-1-^{14}C in the presence of different substrates and cofactors, and the recovery of ^{14}C in fatty acids was estimated. To study the effect of CO_2 on fatty acid synthesis, $^{14}CO_2$ fixation by fat body homogenates was investigated. The effect of malonate on fatty acid synthesis was studied via the metabolism of malonate by fat body preparations, use being made of malonate-1-^{14}C.

(See also II/402)

404 Tietz, A. FAT TRANSPORT IN THE LOCUST: THE ROLE OF DIGLYCERIDES. Europ. J. Biochem. 2 (1967) 236-242.

An analysis of the lipids of the fat body of Locusta migratoria showed that approx. 97% are triglycerides and 2-3% diglycerides; free fatty acids and phospholipids were present only in small amounts. In the haemolymph, diglycerides and phospholipids were the major lipid components; free fatty acids were present in very small amounts, triglycerides were absent. The concentration of the diglycerides in the haemolymph was found to increase with the age of the locust and during sustained flight; the phospholipids remained constant. The concentration of the free fatty acids in the tissue and haemolymph was also increased during flight. When fat body tissue was incubated in vitro with (1-^{14}C)-palmitate, the acid was incorporated into the di- and triglycerides of the tissue. The specific activity of the diglycerides was at least 50 times higher than that of the triglycerides. When prelabelled tissue was transferred into a medium containing haemolymph, diglycerides were released into the medium. The amount of diglyceride released was dependent on the time of incubation and on the amount of haemolymph which was added to the medium. Although the amount of diglycerides which was released, was greater than their concentration in the tissue, the amount of the latter did not change. However, their specific activity was very markedly reduced. When the fat body tissue was prelabelled in vivo and the specific activity of the di- and triglycerides was identical, the specific activity of the diglycerides was not reduced during diglyceride release. When fat body tissue of locusts after flight was incubated with (1-^{14}C)-palmitate, incorporation of the acid into the diglycerides was very markedly reduced. This inhibition was reversed by the addition of glucose to the medium. When prelabelled tissue of locusts after flight was incubated in haemolymph obtained from the same locusts, diglycerides and free fatty acids were released into the medium. (Auth.)

405 Wlodawer, P., Lagwińska, E., Barańska, J. ESTERIFICATION OF FATTY ACIDS IN THE WAX MOTH HAEMOLYMPH AND ITS POSSIBLE ROLE IN LIPID TRANSPORT. J. Insect Physiol. 12 (1966) 547-560.

Haemolymph of wax moth larvae (Galleria mellonella L.) was incubated with 1-^{14}C-palmitate at 37°C for various periods. Gradual esterification of free fatty acids occurred in the haemolymph concomitantly with hydrolysis of some ester bonds. Incorporation of ^{14}C-palmitate took place predominantly in the triglyceride fraction of the haemolymph lipids. Very little radioactivity was found in the diglycerides, which represent the largest fraction of the glycerides in the haemolymph of the larvae. Incorporation of ^{14}C-palmitate was strongly inhibited by sodium chloride and sodium fluoride, known inhibitors of lipoprotein lipase and pancreatic ('true') lipase, respectively. The incorporation of labelled fatty acid was found to take place chiefly at the α-position of the glyceride molecule. The process of esterification may represent an exchange reaction between free fatty acids and glyceride fatty acids, catalysed by lipases present in the haemolymph. (Auth.)

406 Wlodawer, P., Łagwińska, E. TRANSPORT OF LIPIDS IN WAX MOTH LARVAE. p.179 of "Abstracts of Communications of 3rd FEBS Meeting, Warsaw, Poland, 24 Apr. 1966". New York, Academic Press, 1966.

The fat body of fully grown wax moth larvae extensively takes up ^{14}C-palmitate from a buffered medium and esterifies part of it into the triglycerides of the tissue. Concomitantly with the synthesis of the glycerides a continuous release of FFA takes place from the fat body. This may indicate that at least a part of the tissue triglycerides is in a state of dynamic equilibrium. Both the release and esterification of fatty acids are strongly inhibited by lipase inhibitors. When the "labelled" fat body is incubated in the wax moth haemolymph radioactivity appears in the haemolymph lipids, especially in the triglyceride fraction. Diglycerides which represent the largest fraction of the haemolymph lipids contain only little radioactivity, and the FFA fraction even less. In order to elucidate whether the FFA released from the fat body can be esterified in the haemolymph itself, ^{14}C-labelled palmitate was added to isolated haemolymph. It has been found that the labelled fatty acid is extensively incorporated into lipid esters, predominantly into the TG fraction. These and additional results, based on determinations of liberated glycerol, indicate that the fatty acids released from the "prelabelled" fat body are esterified in the haemolymph, thus leading to formation of radioactive triglycerides. The esterification takes place predominantly at the α-position of the glyceride-glycerol and it may represent an exchange reaction catalysed by lipase present in the wax moth haemolymph. Like the lipids in the fat body, part of the haemolymph lipids present as lipoprotein complexes undergo rapid breakdown and resynthesis. It seems that the haemolymph lipids may serve as an additional depot of fatty acids readily available for immediate use by other tissues. (Abstr.)

407 Wlodawer, P., Łagwińska, E. UPTAKE AND RELEASE OF LIPIDS BY THE ISOLATED FAT BODY OF THE WAX MOTH LARVA. J. Insect Physiol. 13 (1967) 319-331.

When isolated fat body of the wax moth larva was incubated with 1-^{14}C-palmitate the fatty acid was readily incorporated into neutral lipids. There was a positive correlation between the concentration of fatty acid in the medium and the amount incorporated into tissue glycerides. The process of triglyceride synthesis involves diglycerides as intermediates; a possible role of tissue lipases is suggested. Hydrolysis of triglycerides and formation of free fatty acids seem to occur before incorporation of triglyceride fatty acids from the medium into the tissue lipids. When the fat body labelled by incubation with 1-^{14}C-palmitate was reincubated in wax moth haemolymph, radioactivity appeared in the triglyceride and free fatty acid fractions of the haemolymph. It is suggested that the fat body of the wax moth larva releases into the haemolymph free fatty acids which are partly resynthesised into triglycerides and are partly transported as free fatty acids bound to protein. (Auth.)

408 Zandee, D.I. ABSENCE OF CHOLESTEROL SYNTHESIS AS CONTRASTED WITH THE PRESENCE OF FATTY ACID SYNTHESIS IN SOME ARTHROPODS. Comp. Biochem. Physiol. 20, 3 (1967) 811-822.

After administration of acetate-1-^{14}C, absence of cholesterol synthesis was demonstrated in the lobster Homarus gammarus, the spider Avicularia avicularia, and in the millipede Graphidostreptus tumuliporus. The animals utilize acetate for the synthesis of fatty acids (except for polyunsaturated ones) and for some non-saponifiable lipids. Gas-liquid chromatography demonstrated even- and odd-numbered fatty acids, saturated and unsaturated ones, iso, anteiso and probably neobranched-chain fatty acids. The fatty acid composition of the mixtures from the animals and the biosynthesis of the fatty acids are discussed. (CA 66: 1967, 83452k)

409 Zielińska, Z.M., Dominas, H. THE ORIGIN OF PHOSPHOLIPID ETHANOLAMINE AND CHOLINE IN A SAWFLY, Acantholyda nemoralis. J. Insect Physiol. 13, 12 (1967) 1769-1779.

The origin of phospholipid ethanolamine and choline was investigated in A. nemoralis by injecting the larvae with ^{14}C formate as a precursor of 3-C of serine. Phospholipids were then extracted and chromatographed on silicic acid and alumina columns. The homogeneity of each of the fractions was checked using thin-layer chromatography, and their nature was proved by means of paper chromatography of the products of the mild alkaline hydrolysis. The predominant phospholipids are stated to be those containing choline (64%) and ethanolamine (23%). The radiocarbon was detected in all phospholipids including the cardiolipin-like acidic phosphatides. The highest specific radioactivity was found in the phosphatidylethanolamine fraction, containing labelled phosphatidylmonomethyl- and phosphatidyldimethylethanolamine. The probable pathways of the biosynthesis of phosphatidylethanolamine and phosphatidylcholine in A. nemoralis are discussed. In A. nemoralis and in C. morosus the specific radioactivity of the total phospholipids after treatment with 3-^{14}C-serine was higher than that after injection of ^{14}C-formate, especially when administered together with homocysteine, a known precursor of methionine. In insects the hydroxymethyl group of serine may really serve as a precursor of the methyl group of phospholipids.

See also:

40 Some biochemical aspects of insect metamorphosis. (Gilbert, L.I. et al., 1961)
84 Permeability of the ganglia of the willow aphid, Tuberolachnus salignus, to organic ions. (Toppozada, A. et al., 1967)
130 Intermediary metabolism of nitrogenous and lipid compounds in insects. (Chefurka, W., 1965)
286 Effects of substrates on gene-controlled enzyme activities in cultured embryonic cells of Drosophila. (Horikawa, M. et al., 1967)
420 The release of triglycerides and free fatty acids from the fat body of the cockroach, Periplaneta americana. (Cook, B.J. et al., 1967)
421 The larval fat body of Sarcophaga bullata (Diptera) as a system for studying phospholipid biosynthesis. (Crone, H.D. et al., 1966)
891 Observations on the mode of action of 2-imidazolidinone, a female sterilant of the adult housefly Musca domestica L. (Diptera: Muscidae). (Wickramasinghe, D.N.T., 1965)

1.2.7. Organic Acids

410 Johnston, N.C., Law, J.H., Weaver, N. METABOLISM OF 9-KETODEC-2-ENOIC ACID BY WORKER HONEYBEES (Apis mellifera L.). Biochemistry 4 (1965) 1615.

Inactive title compound → corresponding ketal ester, ozonisation, condensation of the C_8-aldehyde with malonic acid-2-^{14}C by the method of Jaeger and Robinson (Tetrahedron 14, 320) → 45% 9-ketodec-2-enoic acid-2-^{14}C and 52% 3-ene-isomer; separation by a selective esterification procedure; specific activity 9.6×10^6 dpm/mg. (J. Labelled Compounds)

411 Levenbook, L. ORGANIC ACIDS IN INSECTS . III. CITRATE OXIDATION AND TURNOVER DURING METAMORPHOSIS OF THE SOUTHERN ARMYWORM Prodenia eridania. Acta biochim. pol. 13, 4 (1966) 405-416.

The dynamics of citrate metabolism at various stages of the life cycle of the southern armyworm (P. eridania) were studied following the injection of citrate-1,5-^{14}C. At all stages of development, the radioactive citrate was oxidized to $^{14}CO_2$ and converted to labelled glutamate. These reactions indicate the functioning of the Krebs cycle and were employed to assess its activity from larva to adult. Both cycle activity and total radiochemical yield decreased in the order: adult > larva and early pupa > developing (pharate) adult. Oxidation rates and radiochemical yields followed distinctly U-shaped curves during adult development. Kinetic measurements on the larva indicated a miscible citrate pool of 8.1 μM, with a half-life of 1.6 h and a turnover rate of 3.5 μM/h. The decreasing citrate pool during metamorphosis is probably due to a decreased rate of citrate synthesis. (CA 66: 1967, 44521n)

412 McEnroe, W. IN-VIVO PREFERENTIAL OXIDATION OF UREIDE CARBON No. 2 OF URIC ACID BY Periplaneta americana. Ann. ent. Soc. Am. 59, 5 (1966) 1011.

Uric acid ^{14}C-labelled on C-2(I) and C-8(II) was injected into the adult female cockroach (1.65 mg suspension in 16.5 µl vegetable oil) and the respiratory CO_2 in the following 24 h was precipitated as $BaCO_3$, weighed, and counted at infinite thickness. P. americana (L.) injected with I and II produced an average of 5% of the injected activity in $^{14}CO_2$, and the I-cockroaches produced an average of 8% of the injected activity in respiratory $^{14}CO_2$. These results indicate a preferential oxidation of ureide carbon-2, assuming that equal amounts of uric acid were available for degradation. Paper chromatography of extracts of I-injected cockroaches (phenol, H_2O saturated; tert-butanol formic acid, H_2O: 7: 1: 1) showed activity only in uric acid. The results are discussed in the light of data from elsewhere.

413 McEnroe, W. EXCRETION OF URIC ACID IN Periplaneta americana. Ann. Ent. Soc. Am. 59, 5 (1966) 1012-13.

^{14}C-uric acid was injected into the bodies of adults, and internal organs were subsequently tested for radioactivity either 12 h or 12 d later. The only significant activity was found in the fat bodies and the Malpighian tubules. This activity was extracted with hot 1% LiCl solution, added to the carrier uric acid, and carried through three recrystallizations, indicating that the activity was in uric acid. The Malpighian tubules are therefore able to remove uric acid from the blood and eliminate it into the gut.

414 Mitlin, N., Mauldin, J.K. URIC ACID IN NITROGEN METABOLISM OF THE BOLL WEEVIL: A PRELIMINARY STUDY. Ann. ent. Soc. Am. 59, 4 (1966) 651-653.

Uric acid is stored in the tissues of the boll weevil, Anthonomus grandis Boh., throughout its life cycle, but guanine does not appear to be stored. Apparently no meaningful relationship exists between the total body content of nitrogen and uric acid. However, uric acid appears to be in a dynamic state and is evidently involved in N metabolism, since uric acid-2-^{14}C injected into metamorphosing weevils causes labelling of at least six of the free amino acids. For the metabolic study, uric acid-2-^{14}C of relatively high specific activity (8.23 mCi/mM) was dissolved in lithium carbonate (0.6%) and injected into 1st-stage pupae. Preliminary testing had shown it to be nontoxic to the weevil.

415 Stumper, R. AMEISENSÄURE-SEKRETION DER FORMICINEN. (Formic acid secretion of Formicidae.) Naturwissenschaften 51 (1964) 277-279. (In German)

The aqueous secretion from the poison gland of Formica polyctenea contains free formic acid (I) at a concentration of 55-65%, ~ 3% amino acid, and some aromatic substances. The biosynthesis of I is not understood. In the animal organism it may be the result of oxidation of the labile methyl groups of methionine, choline, betaine, or sarcosine. Formation from acetone or acetic acid may also be envisaged. Systematic feeding of ^{14}C-labelled potential precursors are proposed in order to determine whether a serine-glycine transformation or other substances play a significant part in the biosynthesis of I.

See also:

349 RNA, protein, and uric acid content of body tissues of Periplaneta americana (L.) as influenced by corpora allata during ovarian development. (Thomas, K.K. et al., 1966)

537 Uric acid metabolism by symbiotic bacteria from the fat body of Periplaneta americana. (Donnellan, J.F. et al., 1967)

1.2.8. Antimetabolites

See:

288 Effects of actinomycin D on nucleic acid metabolism and protein biosynthesis during metamorphosis of Tenebrio molitor. (Ilan, J. et al., 1966)

1.2.9. Cell. Tissue. Organ

416 Bier, K. ZUR FUNKTION DER NÄHRZELLEN IM MEROISTISCHEN INSEKTENOVAR UNTER BESONDERER BERÜCKSICHTIGUNG DER OOGENESE ADEPHAGER COLEOPTEREN. (Study on the function of nurse cells in meroistic insect ovaries, with special reference to oogenesis in adephagous Coleoptera.) Zool. Jb., Physiol. 71 (1965) 371-384. (In German)

RNA metabolism in polytrophic meroistic ovaries of adephagous coleoptera(1), lepidoptera(2), and hymenoptera(3) was examined, using ^{3}H-uridine (specific activity 500 mCi/mM). Ovarian proteins were studied by means of ^{3}H-L-histidine (specific activity 1.1 Ci/mM). The doses injected in aqueous solution were ~20 µCi for Carabus, Vespa, and Malacosoma, and ~10 µCi for Formica. Between the start of the growth period and the completion of oogenesis the oocyte nucleus takes no, or hardly any, part in RNA synthesis. Nor does any RNA synthesis occur in the accessory nuclei of the hymenopteran oocyte. The nurse cell nuclei synthesise RNA intensively during that period. The RNA requirements of the euplasmatically growing oocyte is met by the nurse cells which pass on RNA to oocyte during their period of function. There is no indication of any simultaneous protein transfer, nor of an active part played by the follicle epithelium in supplying the oocyte with RNA. When the nurse cells begin to degenerate, cytoplasm rich in RNA passes into the oocyte. The speed of the macromolecular RNA passing into the oocyte is very variable, which reflects their heterogeneity. The existence of a rapidly moving RNA-fraction of high metabolic rate is discussed.

(1) Carabus canellatus Ill. and C. granulatus L.
(2) Malacosoma neustria L.
(3) Formica polyctena Förster and Vespa vulgaris L.

417 Bier, K. OOGENESE, DAS WACHSTUM VON RIESENZELLEN. (Oogenesis, the growth of giant cells.) Naturwissenschaften 54, 8 (1967) 189-195. (In German)

Review article, freely illustrated with results drawn particularly from insects (Locusta migratoria, Musca domestica). The use of tritiated amino acids and RNA precursor has been widespread in attempts at elucidating the sequence of processes involved in oogenesis.

418 Bier, K., Kunz, W., Ribbert, D. STRUKTUR UND FUNKTION DER OOCYTENCHROMOSOMEN UND NUKLEOLEN SOWIE DER EXTRA-DNS WAEHREND DER OOGENESE PANOISTISCHER UND MEROISTISCHER INSEKTEN. (Structure and function of oocyte chromosomes and nucleoli and extra-DNA during the oogenesis of panoistic and meroistic insects.) Chromosoma 23, 2 (1967) 214-254. (In German)

Panoistic ovaries (without nurse cells) contain three predominating structures: lampbrush chromosomes, multiple nucleoli, and the hitherto undescribed endobody (Binnenkörper). Nucleoli are always multiple during the growth period of the oocyte of panoistic ovaries. This is true even in the case of Blattella which seems to possess only one big nucleolus, if examined in the light microscope. In the meroistic type of ovary (with nurse cells) the development of nucleoli and lampbrush chromosomes in the oocyte is much reduced. Only in the early growth stages of the oocyte the chromosomes despiralize in a species-specific degree before they condense to a karyosphere. On the other hand, the endobody is bigger in the meroistic than in the panoistic ovary. Lampbrush chromosomes and multiple nucleoli are sites of a very intensive RNA-synthesis. The nucleoli are built up by granules measuring 125 Å in diameter. In the endobody, no RNA-metabolism could be demonstrated. The endobody is very homogeneous in electron microscope pictures and clearly distinct from the granular nucleoli. The labelling pattern after incubation with ^{3}H-amino acids suggests a permanent exchange of protein molecules between the karyoplasm and the endobody. In the meroistic type of ovary the oocyte obtains RNA from the nurse cells, and RNA-synthesis in the oocyte nucleus is decreased in the same measure as its chromosomes are condensed. The water-beetles Dytiscus and Acilius possess extra-DNA and deviate from the rule of restricted

RNA-synthesis in the oocyte nucleus of the meroistic ovary albeit their chromosomes form a karyosphere too, and RNA streams also from the nurse chamber into the ooplasm. The extra-DNA resolves itself into a network of fine fibrils no longer stainable by the Feulgen reaction. True multiple nucleoli develop on the fibrils suggesting the extra-DNA contains a huge mass of nucleolus organizers. The case of Dytiscus is very similar to the development of the multiple nucleoli in Gryllus.

419 Condoulis, W.V., Locke, M. THE DEPOSITION OF ENDOCUTICLE IN AN INSECT, Calpodes ethlius Stoll (LEPIDOPTERA, HESPERIIDAE). J. Insect Physiol. 12, 3 (1966) 311-323.

Intermoult endocuticle is laid down progressively in the 5th instar of C. ethlius. The incorporation of cuticular precursors into the intermoult endocuticle has been followed autoradiographically. The uptake of general cuticular precursors in the intermoult period is fast enough to clear most of an unchased pulse of ^{14}C-acetate from the haemocoele to the edge of the epidermis and into the cuticle in 2 h. There are two patterns of incorporation, layered and diffuse. ^{3}H-glucose, a precursor of chitin, is incorporated in discrete layers corresponding to the new cuticle synthesised during the period of incorporation and deposited at the edge of the epidermis. ^{3}H-amino acids, L-proline-^{3}H, L-histidine-^{3}H, L-tryptophan-^{3}H, L-tyrosine-^{3}H, L-phenylalanine-^{3}H, on the other hand, are incorporated not only in layers but also diffusely throughout the thickness of the cuticle. L-cystine-^{35}S was diffusely incorporated in the endocuticle and also heavily in the epidermis. The cuticle stretches during the instar as the larva feeds and grows. In spite of this, electron microscopical observations on the thickness of the lamellae suggest that an increase in separation of the first formed lamellae takes place by the end of the instar, presumably as a result of the material added in the diffuse form of incorporation. These experiments suggest that the endocuticle grows both by the addition of lamellae at the epidermal surface and by intussusception.

420 Cook, B.J., Eddington, L.C. THE RELEASE OF TRIGLYCERIDES AND FREE FATTY ACIDS FROM THE FAT BODY OF THE COCKROACH, Periplaneta americana. J. Insect Physiol. 13, 9 (1967) 1361-1372.

For radioisotope studies, the fat body was labelled by incubating the tissues for 60 min with 0.25 μCi of 1-^{14}C-palmitate (specific activity 143 μCi/mg) in a 1 ml phosphate-saline medium. Gravimetric, colorimetric, and radioisotope analyses showed that the triglycerides and free fatty acids were the major lipids released from the fat body after incubation with haemolymph. The time course of triglyceride release was initially rapid; within 30-60 min, however, the process slowed to a standstill. The limiting factor in release was not the fat body but the saturation of the medium. The optimum release of triglyceride occurred in medium which exceeded a concentration of 50% haemolymph, and mobilization of the triglycerides was haemolymph specific. The mechanisms of lipid mobilization and their control are discussed.

421 Crone, H.D., Newburgh, R.W., Mezei, C. THE LARVAL FAT BODY OF Sarcophaga bullata (DIPTERA) AS A SUSTEM FOR STUDYING PHOSPHOLIPID BIOSYNTHESIS. J. Insect Physiol. 12 (1966) 619-624.

The larval fat body of S. bullata was shown to be an effective system for the study of phosphatidylcholine biosynthesis. ^{32}P-phosphorylcholine and ^{14}C-1,2-choline were used. ^{32}P-phosphorylcholine was incorporated to the extent of 4.7% in 1 h at 30°C. This substrate was a precursor of phosphatidylcholine.

422 Cronin, R.T. AN INVESTIGATION OF SOMATIC REDUCTION DIVISION IN THE HIND-GUT OF THE MOSQUITO Aedes aegypti (L.) USING TRITIUM LABELED THYMIDINE. Diss. Abstr. 26 (1966) 4123.

The somatic reduction in the hind-gut of A. aegypti was investigated using ^{3}H-thymidine as tracer. Larvae were exposed to the ^{3}H-thymidine during different periods of their active life, and sacrificed shortly after pupation or after emergence, and autoradiographs of the hind-gut prepared. The audoradiographs of complexes at various stages of first and later divisions have evidence of such uptake that was generally proportional to the duration of the exposure of the larva to the isotope. However some complexes showed less uptake than did others of the same tissue, while some tissues that had received less exposure showed a greater uptake. Evidently the larval hind-gut cells do not all manufacture DNA at the same rate nor at an even pace. Proof of this is seen in the wide variance of ploidy attained among these cells. The autoradiographs of adult hind-guts showed labelling over

most nuclei, giving evidence that these cells were derived from the giant gomplexes of the larval hind-gut, and not from regenerative cells which are not found in this tissue. These findings confirm the fact that the adult hind-gut is derived from the larval hind-gut complexes. A possible degree of DNA turnover in some cells and tissues may explain some of the differences in labelling of the complexes observed. The reported incorporation of thymidine in extranuclear particles)e.g. mitochondria) may account for some of the extranuclear labelling observed in the study.

423 Daillie, J. INCORPORATION DE LA THYMIDINE TRITIEE DANS L'ACIDE DEOXYRIBONUCLEIQUE DES GLANDES SERICIGENES CHEZ LE VER A SOIE. C. r. hebd. Séance. Acad. Sci., Paris 250 (1960) 3053-3054.

Des chenilles de Bombyx mori, au 4e jour du dernier âge reçoivent, par injection dans l'hémocoele, 3 µCi de thymidine tritiée (900 mCi/mM). Des dosages de thymine, par dilution de thymine-$2^{14}C$, ont été effectués sur le glandes séricigènes provenant de chenilles témoins, au moment de l'injection et 5 j plus tard; ils montrent que la quantité de thymine liée à l'ADN passe, durant ce temps, de 10 à 25 µg environ dans une glande séricigène, une synthèse assez faible lorsqu'on la compare à la croissance pondérale. L'incorporation de la thymidine dans L'ADN est évidemment très rapide puisque la radioactivité maximale apparaît 1 h après l'injection. Ce qui est remarquable est la diminution de l'activité: 3 h après l'injection l'activité spécifique de la thymine isolée a diminué de moitié. La décroissance des activités moyennes entre 4 h et 5 j après l'incorporation est compatible avec l'hypothèse d'une dilution résultant de la synthèse.

424 Daillie, J. METABOLISME DE LA THYMIDINE DANS LA GLANDE SERICIGENE DU VER A SOIE. I. LES PRINCIPALES VOIES SUIVIES PAR LE PRECURSEUR DANS LA GLANDE INCUBEE "IN VITRO". Annls Biol. anim. Biochim. Biophys. 7, 3 (1967) 115-129. (In French, with English summary)

The silk gland (secretory tube) of the silkworm was incubated in vitro for a few hours. Under these experimental conditions, the metabolic pathways of ^{3}H-thymidine were analysed in the gland. It was found that (i) the nucleoside penetrates easily into the glandular cells where it converts to nucleotides. Catabolic reactions are negligible. (ii) The total amount of nucleotides increases to a max. reached within 30 min and maintained for at least 30 min. The nucleotides formed in the cells partly turn back to the incubation medium. The silk gland contains, previous to the incorporation of thymidine, the phosphorylating kinases required to convert thymidine to TMP(1), TDP(2), and TTP(3). The evolution of the distribution of radioactivity between these thymidine-phosphates is rather intricate during the first half-hour. (iii) The precursor incorporates into DNA at constant speed. DNA labelling thus seems insensitive either to variations in the amount of TTP and to increases in radioactive nucleotides. Various interpretations of these findings are discussed.

(1) thymidine monophosphate.
(2) thymidine diphosphate.
(3) thymidine triphosphate.

425 Daillie, J. METABOLISME DE LA THYMIDINE DANS LA GLANDE SERICIGENE DU VER A SOIE. II. UTILISATION DES NUCLEOTIDES RADIOACTIFS POUR LA SYNTHESE DE L'ADN DANS LA GLANDE INCUBEE "IN VITRO" AU 4e JOUR DU 5e STADE. Annls Biol. anim. Biochim. Biophys. 7, 3 (1967) 227-243. (In French, with English summary)

1. Une partie des nucléotides thymidyliques marqués accumulés dans les glandes séricigènes incubées in vitro s'échange facilement avec le milieu d'incubation. L'utilisation relative des nucléotides subit une diminution marquée dans les premières minutes de l'incubation en présence de thymidine radioactive. Cependant le marquage de l'ADN s'effectue à vitesse constante. Ces faits suggèrent qu'une partie seulement des précurseurs, après phosphorylation, est directement disponible pour la synthèse d'ADN. La radioactivité de ce compartiment actif atteindrait en quelques minutes un niveau élevé, maintenu ensuite à peu près stable. 2. La quantité de thymidine présente dans le milieu au début de l'expérience retentit sur la taille du pool radioactif et sur sa participation à la synthèse d'ADN, ce qui conduit à admettre que le compartiment actif entre en compétition avec les précurseurs endogènes. 3. La synthèse horaire d'ADN qui se produit dans l'organe explanté est comprise entre 0,20 et 0,40 p. 100 de son contenu en acide nucléique, c'est-à-dire entre 1/5 et 1/3 de la quantité d'ADN produit in situ. Le pool endogène permanent représente environ la quantité de nucléotides nécessaire pour assurer la synthèse d'ADN pendant une demi-heure. - Différents modèles capables de rendre compte des échanges entre les compartiments sont discutés. (Aut.)

426 Daillí, J. METABOLISME DE LA THYMIDINE DANS LA GLANDE SERICIGENE DU VER A SOIE. III. INCORPORATION DANS LA GLANDE SERICIGENE PRELEVEE AU 6e JOUR DU 5e AGE ET INCUBEE "IN VITRO". Annls Biol. anim. Biochim. Biophys. 7, 3 (1967) 347-354. (In French, with English summary)

Bien que la synthèse de l'ADN soit réduite dans la glande sérigène au 6e jour du 5e âge larvaire, la thymidine fournie à l'organe incubé in vitro pénètre avec facilité par diffusion. Mais l'activité des kinases qui assurent la phosphorylation du nucléoside se trouve affaiblie par rapport à ce qu'on a observé avec des glandes jeunes. La production des nucléotides dépasse toutefois les possibilités de leur utilisation par l'ADN. Ce dernier incorpore le précurseur à un taux très faible. Lorsqu'on fait varier la concentration du milieu en thymidine, on atteint très vite, dans l'ADN, l'incorporation maximum du précurseur. Celle-ci représente, au plus, une synthèse d'acide nucléique de 0,5 p. 1000 à l'heure. On n'a pu évaluer avec précision la quantité de précurseurs thymidyliques endogènes disponible en permanence: cette réserve, qui ne paraît pas pouvoir assurer plus de 15 minutes de synthèse, représente environ 0,1 p. 1000 de la quantité de thymine contenue dans l'ADN des glandes. - L'intervention éventuelle des kinases de la thymidine ou de la production des précurseurs endogènes dans la régulation de la synthèse d'ADN est discutée. (Aut.)

427 Daillie, J. METABOLISME DE LA THYMIDINE DANS LA GLANDE SERICIGENE DU VER A SOIE. IV. ETUDES SUR LA GLANDE "IN SITU". Annls Biol. anim. Biochim. Biophys. 7, 3 (1967) 355-372. (In French, with English summary)

1. Le transfert du nucléoside injecté dans l'hémocoele vers les organes, et en particulier la glande sérigène, se réalise à grande vitesse. Aux 3e et 4e jours, la majeure partie de la thymidine disparaît de l'hémolymphe en l'espace de 10 à 15 minutes. Ce phénomène résulte d'une transformation immédiate du nucléoside introduit. Au 3e jour, 15 minutes après injection d'une dose traceuse de thymidine, la radioactivité soluble dans la glande apparaît entièrement sous la forme de nucléotides, ou de composés de dégradation. 2. Les nucléotides radioactifs se trouvent à bref délai incorporés au pool d'utilisation et, ainsi, mêlés aux précurseurs endogènes. Il est donc possible, en première approximation, d'assimiler la vitesse de disparition des nucléotides marqués à la vitesse de renouvellement du pool endogène. On a pu évaluer que ce renouvellement, au 3e jour, s'effectue 0,6 fois par heure. 3. Dans ces conditions, l'ADN incorpore le précurseur très rapidement, dès le début de l'expérience. La vitesse du marquage se ralentit ensuite; la radioactivité maximum de l'acide nucléique est atteinte après 2 à 8 heures, aux 3e et 4e jours. Après ce maximum, la décroissance de la radioactivité spécifique permet de mesurer la synthèse d'ADN qui se produit dans la glande. 4. Avec des chenilles plus âgées (6e jour), on note essentiellement un ralentissement des divers processus. - Ces résultats sont comparés à ceux qu'on a obtenus in vitro. (Aut.)

428 Ehrhardt, P. UNTERSUCHUNGEN ÜBER BAU UND FUNKTION DES VERDAUUNGSTRAKTES VON Megoura viciae Buckt. (APHIDIDAE, HOMOPTERA) UNTER BESONDERER BERÜCKSICHTIGUNG DER NAHRUNGSAUFNAHME UND DER HONIGTAUABGABE. (Study of the structure and function of the alimentary tract of Megoura viciae Buckt. (Aphididae, Homoptera), with special reference to food uptake and honeydew excretion.) Z. Morph. Ökol. Tiere 52 (1963) 597-677. (In German)

The structure of the alimentary tract was investigated and described. From p. 641 on, tracer experiments are described. The aphids were labelled via their host plants. Young 15-cm Vicia fabae had their roots dipping into an isotonic orthophosphate solution (pH 6-7, activity 5 mCi/ml). M. viciae is essentially a phloem feeder so that isolated leaves were only used in special cases, particularly when a higher isotope concentration was desired in the parenchyma. Aphids were placed on the plants 48 h after labelling. The aphid uses a trial and error technique to find the sieve tubes. It pierces intercellularly through the parenchyma of the plant. The pricking behaviour of starved and sucking animals differs. Neither type, however, takes up any ^{32}P from the tissues in their brief (up to 60 sec) probing. Taste probes are not made in the parenchyma itself. At the earliest, ^{32}P is taken up 7 min after the plant has been pricked. In that period the aphid may have reached a sieve tube although it may take up to 1 h. The variation in time is very considerable. About 60% of the aphids reach the phloem 1 h after the plant has been pricked. Once the sieve tube has been pierced the quantity of ^{32}P taken up, up to its first elimination, not for 3 h at least, is linearly related to the duration of sucking. After 24 h the animal is already satiated with tracer. Starved animals take up ~10% more. The aphid apparently only recognizes the suitability of a

plant as a host after reaching the phloem. Tracer appears in aphid haemolymph 30 min, at the earliest, after the onset of sucking. It can be detected, at the earliest, after 6 h in larvae, 4 h in saliva, and 2½ h in deposited honeydew. As for honeydew, there is a rise with increasing aphid age in deposition, the volume of the drops, and the rate of excretion. There is no relation between honeydew deposition and the birth of larvae or the time of day. There is, however, a rise in the frequency of deposition and excretion with temperature. Honeydew deposition is not a continuous process: periods of excretion (average 8.26 h) are followed by intervals (~3.76 h), indicating that food uptake is no continuous process either. The stream of sap from the sieve tubes can, presumably, be stopped with the so-called suction pump. Fasted animals do not have periods of no-excretion. Their excretion rate and their feeding rate are also higher than those of the sucking aphids. The quantity of food absorbed can be regulated by the aphids, using their suction pump.

429 Eldefrawi, M.E., O'Brien, R.D. PERMEABILITY OF THE ABDOMINAL NERVE CORD OF THE AMERICAN COCKROACH, Periplaneta americana (L.) TO ALIPHATIC ALCOHOLS. J. Insect Physiol. 13 (1967) 691-698.

The rates of influx and efflux of ^{14}C- and ^{3}H-labelled aliphatic alcohols* in the abdominal nerve cord of the American cockroach were studied. Influx was biphasic and positively correlated with octanol/water partition coefficients, with a cut-off point at butanol. All alcohols, except methanol, established a higher concentration inside the nerve cord than outside within 60 min exposure. Influx rates of alcohols were lower than their analogous fatty acids, the difference being attributed to the absence of metabolism of the alcohols in the nerve cord. Compared to the analogous cations, the alcohols had higher influx rates, yet when comparing an alcohol with a cation with similar partition coefficient the influx rates were similar. Charge therefore seems to lower influx because it increases the polarity. Efflux of the alcohols is characterized by a two-stage process with simultaneous rapid and slow phases. Based on the rates of the fast efflux, the nerve sheath appears to be equally permeable to alcohols and tetra-alkylammonium cations and 2-5 times less permeable to fatty acids. (Auth.)

*Methyl alcohol-^{14}C (specific activity 10 mCi/mM), ethyl alcohol-2-^{3}H (specific activity 753mCi/mM), butyl alcohol-, hexyl alcohol-, and octyl alcohol-1-^{14}C (specific activity 1 mCi/mM) were all available commercially.

430 Feir, D., O'Connor, G. TRITIATED THYMIDINE STUDIES ON INSECT HEMOCYTES. p.233 of "Proceedings of the 12th International Congress of Entomology. London, England, 8-16 Jul, 1964". 1965.

The large milkweed bug, was the experimental animal in these studies. ^{3}H-thymidine was injected into different groups of Oncopeltus fasciatus on the day of moult into the 5th instar and on successive days after the moult for the duration of the stadium. Two experimental and two control insects from each group were sacrificed and haemolymph smears were made every 24 h after the injection for the duration of the stadium. The slides were dipped in Kodak NTB2, stored in light tight boxes at 4-8 °C for 8 d, developed in D19, rinsed in acid fixer and water, and stained with Giemsa blood stain for 15 min. 150 cells on each slide were counted. The percentage of haemocytes with ^{3}H-thymidine incorporation, the percentage of mitotic figures, and the percentage of mitotic figures with ^{3}H-thymidine incorporation were determined. A haemocyte was considered to have radioactive incorporation if the number of reduced silver particles in the emulsion over the nucleus was at least twice the background. With one exception there was no appreciable incorporation until 48 h after injection regardless of when the injection was given, a surprising delay since most investigators report that the thymidine is used within 60 min of injection. There is the possibility that the majority of the haemocytes are formed in a haemopoietic organ or site and then released into the circulating haemolymph. In most cases the peaks of haemocytes with incorporation occurred on the 5-6 d and the 9-10 d after the moult into the 5th instar regardless of when the injections were given. When the ^{3}H-thymidine was injected on the 9th or 10th day of the stadium, i.e. 48 or 24 h before the adult moult, there was no incorporation although there was incorporation on these days when the injections were made earlier in the stadium. When ^{3}H-thymidine was injected on the 4th or 5th day after the stadium, which lasted 10-11 days under laboratory conditions, there was very little incorporation for the entire stadium. This suggests little DNA synthesis in the haemocytes or haemopoietic tissue at this time or that another tissue is much more active mitotically at this time and it is utilizing the ^{3}H-thymidine. When the injections were made early in the stadium there was a 2nd peak of incorporation around the 9th or 10th day after the moult and approx. 4

or 5 d after the 1st peak of cells with incorporation. There was a consistent low level of mitosis throughout the stadium. The percentage of mitosis, or mitotic index, varied from 0-15. No correlation of the higher peaks of mitotic activity with age, time of injection, time of day when the haemolymph was taken, or high peaks of thymidine incorporation could be seen. The percentage of mitosis with ^{3}H-thymidine incorporation varied from 0-100. (From abstr.)

431 Halkka, O., Heinonen, L. RADIOAUTOGRAPHIC STUDIES ON THE GONADS OF Acheta domesticus (L.). Annls Med. exp. Biol. Fenn. 44 (1966) 120-124.

In Acheta domesticus larvae fixed 6, 24 or 48 h after injection of ^{3}H-thymidine, no label was found in the 64- or 128-cell spermatogonial cysts at metaphase. The 8-, 16- and 32-cell cysts were labelled 48 h post injection. Under the test conditions employed, neither the nucleus nor the cytoplasm of the oocyte was found to incorporate or absorb radioactive thymidine in macromolecules or other structures not washed away by the subsequent treatment of the sectioned oocyte. Chloramphenicol or mitomycin C pretreatment did not cause changes in the incorporation pattern of the ovarioles. In the earliest spermatogonial cell generations, one of the chromosomes incorporated ^{3}H-uridine at a time the other members of the genome were inactive. Uridine incorporation into the cytoplasm, nucleolus and nucleus of the oocyte, in this order, was reduced considerably by application of mitomycin C. (Auth.)

432 Münchberg, P. ZUR DURCHBLUTUNG DER LIBELLENFLÜGEL UND IHRER EIGNUNG ALS SUBSTRAT VON PARASITISCHEN Arrenurus-LARVEN (ACARINA, HYDRACHNELLAE). (Haemolymph circulation in the dragonfly wing and its suitability as substrate for the parasitic Arrenurus larvae (Acarina, Hydrachnellae).) Z. ParasitKde. 22 (1963) 375-386. (In German)

$Na_2H^{32}PO_4$ was used and injected into the dragonfly body, the precise position varying with the size of the species used. Details of dosages and exposure times are given. Veination and circulation were demonstrated autoradiographically in the following species: Calopteryx splendens, Libellula quadrimaculata, Somatochlora flavomaculata, Sympetrum vulgatum, S. danae, Platycnemis pennipes, and Lestes sponsa. The dragonfly wing evidently lends itself as a substrate for the larvae of Arrenurus papillator (O. F. Müll.). The basal portions of the thicker veins of S. meridionale Selys and S. fonscolombei Selys are specifically vulnerable to attack by the parasite.

433 Münchberg, P. ZUR ILLUSTRIERUNG DER DURCHBLUTUNGSVERHÄLTNISSE DES LIBELLENKÖRPERS UND SEINER ANHÄNGSEL MIT RADIOAKTIVEN MITTELN. (An illustration, by means of radiotracers, of the way in which haemolymph circulates in the body and appendages of the dragonfly.) Gewäss. Abwäss. 39/40 (1965) 64-79. (In German)

In order to make such circulation visible autoradiography was used which proved particularly suitable for wings and legs. A complete illustration of Odonata circulation by such a technique proved possible only in the smaller Zygoptera: in Anisoptera, only body fragments would be autoradiographed. $Na_2^{35}SO_4$ * proved more appropriate than $Na_2H^{32}PO_4$. Abdominal and thoracic injections were used, the amount depending on the size of the insect (0.025-0.05 ml for Zygoptera, 0.05-0.1 ml for Anisoptera). No noticeable autoradiographic differences were observed between the front and the hind wings. The direction (or existence of reversion) of haemolymph circulation cannot be gauged. Experimental conditions and exposure times are discussed.

* injected in physiological saline.

434 Münchberg, P. APHORISMEN ZUM BAU DES LIBELLENFLÜGELS AUF GRUND SEINER AUTORADIOGRAPHIERUNG MIT $Na_2^{35}SO_4$ UND ZUM SITZ DER FLÜGELPIGMENTE. (Aphorisms on the structure of dragonfly wings, based on autoradiography by means of $Na_2^{35}SO_4$, on the location of wing pigments.) Opusc. zool. 82 (1965) 1-9. (In German)

Autoradiographs demonstrate that the haemolymph entering the wing is only found in the veins and does not circulate among the chitin lamellae as has sometimes been suggested. Details of the method have already been given elsewhere. - Autoradiography was not used in the study on wing pigments.

435 Münchberg, P. ZUM BAU DER LIBELLENFLÜGEL UND NOCHMALS ZUR ILLUSTRATION IHRER DURCHBLUTUNG DURCH INJEKTIONEN VON $Na_2^{35}SO_4$. (Structure of the dragonfly wing and further illustration of its blood circulation by injecting $Na_2^{35}SO_4$.) Dt. ent. Z. 13, 4/5 (1966) 383-391. (In German)

Previous work on various species and with various autoradiographic techniques is discussed. The use of juvenile dragonflies (Libellula depressa) gave very satisfactory results with ^{35}S, probably partly due to the fact that immediately after ecdysis there is intensified circulation of haemolymph. The flattening out of the wings of the imago leaving the exuviae parachute-like, needs to be completed before the chitin has finished hardening. In Odonata an epidermal adherence or interconnection appears to exist between the veins for the formation of an extremely stable wing skeleton. The concept of an intercommunicating tubular network for haemolymph circulation cannot be maintained in the face of the autoradiographs obtained. Diffuse accumulations of haemolymph are indicated between chitin lamellae.

436 Prudhomme, J.C. CONTRIBUTION A L'ETUDE DU METABOLISME DES GLANDES SERICIGENES DE Bombyx mori, INCUBEES IN VITRO. Thesis, Lyon Univ. (France), Sep. 1966, 60p.

Silk glands can be maintained in vitro in media characterized by the presence of lactalbumin hydrolysate as source of amino acids, glycogen as glucidic source, and a salt solution buffered at pH 6.6. A decreasing but sufficiently high respiratory activity can be demonstrated, which persists for at least 20 hours; the glands, in addition, incorporate the exogenous thymidine at a high rate into DNA for at least 13 h. Apart from the temperature, a number of other factors in the medium, which appear to be essentially linked with the glucide content, the total concentration and possibly the ionic force may modify quantitatively the degree of respiratory activity. The quantity of exogenous thymidine incorporated into DNA depends on the presence in the medium of an extract of haemolymph and a lactalbumin hydrolysate. Without them, the incorporation drops rapidly. Whereas the blood extract leads to a kind of equilibrium during incubation, the hydrolysate, over a period of time, stimulates the capacity of the organ to incorporate thymidine into DNA. An optimal medium cannot yet be defined. Nevertheless, the presence of a haemolymph abstract seems essential. - ^{3}H-thymidine was used.

437 Řežábová, B., Landa, V. EFFECT OF 6-AZAURIDINE ON THE DEVELOPMENT OF THE OVARIES IN THE HOUSE FLY Musca domestica L. (DIPTERA). Acta ent. bohemosl. 64, 5 (1967) 344-351. (In English)

In a histoautoradiographic study, the incorporation of labelled precursors of nucleic acid and of ^{14}C-6-azauridine into the normal and 6-azauridine treated ovaries was investigated. ^{3}H-uridine, -cytidine, -uracil, and -thymidine were used. The application of 6-azauridine in food immediately after emergence, and its further continued application resulted in the division of nuclei and nucleoli of the follicular epithelium cells in the ovary and its proliferation. Incorporation of labelled precursors of nucleic acid proved that before the onset of proliferation and during its course, follicular epithelium cells are highly active. The biochemical findings which are in close connection with the anatomical observations showed increased RNA and DNA synthesis in the ovaries of house flies after 6-azauridine application. The degree of incorporation of such nucleic acid precursors into treated ovaries also suggests increased synthesis of RNA and DNA. The action of 6-azauridine on the ovaries is not via the endocrine system but direct.

438 Treherne, J.E. GUT ABSORPTION. A. Rev. Ent. 12 (1967) 43-58.

The physiology of gut absorption is reviewed and the specialization among the absorptive processes of the insect gut is discussed. The article deals with the movement of substances within the gut lumen, the uptake of water and inorganic ions (absorption in the fore- and midgut) and with the absorption of sugars, amino acids and lipids. In some of the studies cited radioisotopes (^{14}C, ^{32}P, ^{42}K, ^{131}I) were used. A bibliography is included, completed in April 1966.

439 Tulchin, N.W. Drosophila SALIVARY GLANDS IN VITRO. Diss. Abstr. 27, 4 (1966) 1040-B - 1041-B.

The salivary glands of 3rd-instar larvae of D. melanogaster were excised and transferred to various insect tissue culture media in order to determine the degree of maintenance and replication in an in vitro system. The two salivary glands of one individual explanted for 24 h to Jones and Cunningham's medium to which ^{3}H-thymidine had been added showed salivary gland nuclei in which chromosomes were completely labelled, completely unlabelled, and partially labelled. The same categories of isotope incorporation in the chromosomes were found after 1 h explantation. A 1-h pulse of ^{3}H-thymidine after 24 h of explantation of salivary glands showed only chromosomes which

were completely unlabelled or partially labelled. These results indicate that total replication of DNA in salivary gland cells can be completed in 1 h at the beginning of explantation, and at the end of 24 h of explantation is much slower or only possible at certain loci of the chromosomes. The pattern of incorporation was analysed in the two salivary glands of one individual explanted for 24 h to Jones and Cunningham's medium with serum to which ^{3}H-thymidine had been added. The chromocentre comprising the heterochromatic regions of the chromosomes was heavily labelled when the nucleus was labelled. There were no nuclei in which the euchromatic portions of the chromosomes were heavily labelled and the chromocentre was unlabelled. Therefore, the heterochromatic regions of the chromosomes replicate asynchronously with respect to the euchromatic regions. The pattern of incorporation in the euchromatic regions was predominantly on the horizontal axis of the chromosome, at specific bands or regions of the chromosomes, and the degree of labelling of euchromatin varied from cell to cell. The nucleolar organizer showed incorporation of ^{3}H-thymidine in totally labelled and partially labelled nuclei. The variability in incorporation of ^{3}H-thymidine among the cells of late 3rd-instar larval salivary glands in vitro is resolvable at the level of the bands of the euchromatic regions of the chromosomes. The degree of labelling of the chromosome complement in each of the cells, when arranged in series, represents stages in the replication of the chromosomes. The salivary glands of late 3rd-instar larvae of D. melanogaster when explanted in vitro present a system in which the pattern of replication of the chromosomes is a reflection of the competence of the cells. The effects of different substances in the external medium, puff-pattern analyses, as well as different genetic combinations, can thus be studied in relation to the pattern of replication of the chromosomes. (From DA)

440 Wan-Yuen, C., Tak-Ming, C. MACRO-AUTORADIOGRAPHIC STUDY OF THE DISTRIBUTION AND TRANSLOCATION OF SEMEN IN THE FEMALE REPRODUCTIVE SYSTEM OF SILKWORM (Bombyx mori). Acta ent. sin. 15, 1 (1966) 65-69. (In Chinese)

Male pupae of B. mori, 3 d before adult eclosion, received 0.02 ml of ^{32}P (using $Na_2H^{32}PO_4$) by injection, giving 1 μCi radioactivity/pupa. Adults were allowed to copulate with virgin females. The reproductive system and the fat body were dissected out of the females at intervals of 10 min, ½ h, 1 h, 5 h, and 9 h after mating. The following was observed: (1) in the spermathecae, Ag grain reduction increased with the interval between dissection and mating; (2) within 5 h after copulation, sperm were beginning to fill the ovariole, with accompanying reduction of Ag; (3) sperm follow a definite pattern along the ducts and will not pass to other organs. - After 9 h, oviposition is completed. After oviposition, the picture is the same as 5 h after mating. ^{32}P can only be traced in the spermatheca and the ovariole. When a labelled pupa develops into an adult moth of either sex, the reproductive system of the adult is radioactive, and Ag reduction is observed. It can be concluded that in B. mori sperm can only pass from the spermatheca to the ovariole. The presence of any sperm along the middle oviduct cannot be determined with any certainty by this method, nor whether any penetration to the outside is possible from spermatheca or the ovariole, other than via the ducts.

441 Wolfsberg, M. F. STUDIES ON OVARIAN STRUCTURE, FUNCTION AND GROWTH IN ADULT Drosophila pseudo-obscura. Diss. Abstr. 27, 12 Pt. 1 (1967) 4253-B - 4254-B.

Ovarian structure, function and growth were studied in adult females by means of the following techniques: Kahle-fixed, Feulgen-stained ovarian whole mounts, daily egg-laying records of individual females and tracer studies involving ^{32}P and 2, 4-dinitrophenol (DNP). Mated and virgin females show a marked periodicity with respect to the number of eggs laid per day. Periods of active egg-laying which last, on the average, for 2 d are followed by periods of rest which last, on the average, for 1 d. The development of an egg in the ovariole has been divided into 14 consecutive stages. The development of the egg chamber, oocyte, nurse cells, follicular epithelium and accessory structures has been described. The stage distribution of oocytes within a given ovariole has been determined for mated females of various ages and in various phases of the egg-laying cycle. Estimates have been given for the time required for an egg to pass through each developmental stage. A model which describes the distribution of oocytes within a given ovariole as a function of time has been suggested. Fluctuations in the stage distribution of oocytes have been correlated with egg-laying behavior. During egg-laying, the ovary contains mature eggs; during rest, it contains immature and intermediate oocytes. A hormonal regulation of the ovarian rhythm involving the corpus allatum has been proposed. DNP, in concentrations of 1×10^{-3} M to 1×10^{-5} M, was added to "standard" food which had been labelled non-homogeneously with ^{32}P. The radioactivity of the

tissues of adult females was later determined. The distribution of ^{32}P within tissues reaches a steady state such that the relative percentage of ^{32}P in each organ remains constant even though the total radioactivity of the fly is increasing. Growth of the ovaries upsets the steady state distribution although the relative percentages of ^{32}P in each organ become constant again after the cessation of ovarian growth. The relative percentage of ^{32}P within the ovary may be correlated with the amount of growth which has occurred in this organ. The distribution of ^{32}P in control and DNP poisoned flies is similar provided that the gonads of both groups have reached the same developmental stage. At 1×10^{-3}M DNP, oocytes do not develop beyond stage 7: at 5×10^{-4}M DNP, ovarian growth is merely delayed. It is difficult to separate the effects of DNP from those of starvation. Excretion of ^{32}P in intact females follows a 2-phase system. A large amount of ^{32}P turns over by means of a slow phase: a small amount turns over by means of a fast phase. Females poisoned with 5×10^{-4}M DNP lose P more slowly than control sibs. When radioactive females are removed to unlabelled food, the growing ovary accumulates ^{32}P until the relative percentage of ^{32}P in the gonad reaches that characteristic of the mature ovary. A mechanism which involves the mobility of phosphorus throughout the fly has been proposed for maintaining the relative ^{32}P-content of various tissues at characteristic values. It has been suggested that DNP may retard ovarian growth by interfering with the production of energy rich compounds which are normally formed during oxidative phosphorylation. (From DA)

442 Zylberberg, L. VARIATION DE LA TENEUR EN GLYCOGENE APRES IRRADIATION DES CELLULES DE LA PAROI DE TESTICULE CHEZ Pieris brassicae. J. microsc. 4, 2 (1965) 172.

Abstract of paper presented at meeting.

For some additional information
on some cellular components, tissues, and organs,
see also:

chromosomes	276, 285.
nucleolus	246, 270, 273, 291, 335, 343-4.
(single) cells	274.
central nervous system	51, 61, 207, 372, 622-3, 637-8, 658-9, 930.
corpora allata	229, 349.
fat body	100, 101, 105-6, 134, 140, 141, 187, 203, 205, 235, 348, 352, 365-8, 389, 398, 403-4, 406-7, 537.
midgut	51, 64-66, 351, 353.
muscle	47, 56, 402.
salivary gland	180, 181, 237, 246, 262, 271, 309, 328, 331, 341, 351.
silk gland	117, 122, 155, 220-1, 258-261, 299, 300, 319, 329, 436.
thoracic tissue	369.
wing	432-5.

1.2.10. Miscellaneous (including Nutrition, Metabolism and Growth Phenomena, Respiration, Metabolism and Accumulation of Chemosterilants and Insecticides)

443 Anonymous. HEALTH IN URANIUM MINING. Int. atom. Energy Ag. Bull. 6 (1964) 26-29.

The principal radiation hazard encountered in mining U and Th arises from the radioactive gases Rn and Tn, and the further dangerous products to which they give rise. In U mines the gas Rn is a decay product of Ra: Rn itself decays rapidly to a series of daughter products, which are solids. The most dangerous radioisotope in U mill wastes was ^{226}Ra. Many detailed studies have taught much about the monitoring and surveillance of various environmental media. Methods used include monitoring of water, of sediments, of aquatic biota (algae, insects, fish), and other media such as mill effluents, soil and crops. (Battelle Geneva Card File)

444 Balboni, E.R. THE RESPIRATORY METABOLISM OF INSECT FLIGHT MUSCLE DURING ADULT MATURATION. J. Insect Physiol. 13, 12 (1967) 1849-1856.

As the maturation of honeybee flight muscle proceeded, distinct patterns in the development of the energetic capabilities of the mitochondria were apparent. Mitochondrial ATPase and ATP-Pi exchange activities were evident in newly emerged bees and exhibited generally parallel increases in activity with increasing age.* Respiratory control by ADP concentration, however, was not apparent in mitochondrial preparations from young, 1-d- and 4-d-old bees. Also, phosphorylation linked to the oxidation of succinate, α-glycero-P or pyruvate + malate was either not apparent or at best negligible during this period of adult life. This, however, may be due to an age-related fragility of the mitochondria rather than to an actual lack of these attributes. The mitochondrial α-glycero-P oxidase system appeared to exhibit considerable activity even during the early stages of adult life after emergence. Most likely, the operation of this system is responsible for mediating a significant portion of the energy production for the limited flight activity exhibited by bees during the early stages of adult life. The pyruvate metabolizing system was not fully functional until relatively late in adult maturation (16-20 d after emergence). This would appear to indicate that sustained flight, exhibited by fully matured flying bees, is possible only when the Krebs cycle is in a fully functional state. (Auth.)

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* For the ATP-Pi exchange studies, 5 μM ^{32}P-Pi (10^6 cpm) were added to the standard assay medium indicated in the article.

445 Carney, G.C. OXIDATIVE PHOSPHORYLATION AND RESPIRATORY CONTROL IN ISOLATED HOUSE FLY MITOCHONDRIA. Bull. ent. Soc. Am. 13, 3 (1967) 193. Abstr. 128. "New York Meeting of the Entomological Society of America, New York, N.Y., 27-30 Nov. 1967".

Mitochondria were allowed to respire with substrate ^{14}C-labelled ADP. Respiratory stimulation by ADP was measured polarographically. ATP, ADP and AMP concentrations were monitored almost continuously. Efficiency of oxidative phosphorylation varied with substrate but bore no relation to the respiratory response to ADP. (Abstr.)

446 Chambers, D.L., Brookes, V.J. HORMONAL CONTROL OF REPRODUCTION. - I. INITIATION OF OÖCYTE DEVELOPMENT IN THE ISOLATED ABDOMEN OF Leucophaea maderae. J. Insect Physiol. 13 (1967) 99-111.

Abdomens of female L. maderae have been isolated and maintained in a viable condition for several months. When acetate-1-^{14}C was injected into isolates about one-half of the label was recovered as $^{14}CO_2$ within 12 h. Glucose-U-^{14}C was oxidized much more slowly and nearly 70% of the label was still retained after 5 d. Leucine-U-^{14}C was readily incorporated into the protein of the fat body, blood, and immature ovaries. Isolation effectively terminated the development of the ovaries, but when active corpora allata were implanted there was an increase of 10-34% in the size of the terminal oöcyte. The data suggest that only the corpora allata are necessary for the initiation of ovarian development, but other factors such as hormone titre and nutritional state may influence the rate at which development takes place. (Auth.)

447 Chandley, A.C. STUDIES ON OOGENESIS IN Drosophila melanogaster with ^{3}H-THYMIDINE LABEL. Expl Cell Res. 44, 1 (1966) 201-15.

Autoradiography of ovaries fixed 30 min after injection of Drosophila females with ^{3}H-thymidine reveals that the labelled germ cells are confined to the anterior region of the germarium. The labelled cells fall into groups of 1, 2, 4, 8 and 16 which presumably correspond to successive generations of oogonia. The amount of label in 2-, 4- and 8-cell groups is proportional to the number of cells in a group, which indicates that the rate of DNA-synthesis is the same over successive oogonial generations. In the case of 16-cell cysts the amount of label appears to be slightly lower than that expected immediately after injection by comparison with the various oogonial cysts, and may indicate a slower rate of synthesis in the oocyte S-period. The early stages of development of the oocyte were followed in material fixed at 3, 6, 12, 24, 48 and 72 h after labelling. The total grain count over a cyst of 16 cells indicates the labelled oogonial generation from which it has differentiated. Cysts of 16 cells with maximum label (i.e. labelled at the meiotic S-period) first appear in the middle of the germarium (Region 2) at 24 h. The first labelled Stage 1 egg-chambers (labelled at the meiotic S-period) were seen at 48 h in the posterior region of the germarium. More were found at 72 h, when the first Stage 2 egg chambers were found. (Auth. summary)

448 Chang, T.H., Riemann, J.G. ^{3}H-THYMIDINE RADIOAUTOGRAPHIC STUDY OF SPERMATOGENESIS IN THE BOLL WEEVIL, Anthonomus grandis (COLEOPTERA: CURCULIONIDAE). Ann. ent. Soc. Am. 60, 5 (1967) 975-979.

The time sequence of spermatogenesis in the boll weevil, A. grandis Boheman, was studied with ^{3}H-thymidine radioautography. The spermatocytes required 10 d to mature into sperm (from the premeiotic DNA synthetic period). Of these, a little more than 4 d is used to reach prophase I, less than 1 d is spent in meiotic division, and more than 5 d is spent in spermiogenesis. The cyst cells, some epithelial cells of the vas deferens, and follicle cells were also labelled with thymidine. (Auth.)

449 Clever, U. PUFFING IN GIANT CHROMOSOMES OF DIPTERA AND THE MECHANISM OF ITS CONTROL. p.317-334 of "The Nucleohistones". Bonner, J., Ts'o, P., Eds. San Francisco, Calif., USA, Holden-Day, Inc. 1964, 398p. Paper presented at "1st World Conference on Histone, Biology and Chemistry, 1963".

Comprehensive review article. Much of the work described was carried out on Chironomus tentans. The role of ecdysone is discussed in detail.

450 Clever, U. CONTROL OF CHROMOSOME PUFFING. p.161-186 of "The Control of Nuclear Activity". Goldstein, L., Ed. Englewood Cliffs, N.J., USA, Prentice-Hall, Inc. 1967.

Review of present data obtained variously and also by the author to elucidate the control of chromosome puffing. - Both the inhibition of protein synthesis and that of RNA synthesis seem to interfere with RNA and protein removal from the puffs. An inducing and a repressive factor appear to control the activity of the IV-2-B locus in Chironomus tentans, both formed - sequentially - by ecdysone stimulation. In Drosophila salivary glands a specific puff was induced by L-tryptophan. Ritossa concluded from results on D. buskii that puffing at certain loci was related to O-metabolism. The effect of actinomycin on uridine incorporation proved to be an inhibiting one. The control of puff formation appears to be ultimately related to RNA synthesis and transport and to protein synthesis. Various interpretations of experimental data are discussed. It is not clear at present whether synthesis or removal of some puff material may be affected by cycloheximide. The author's own studies are described including studies on the role of protein synthesis in the action of ecdysone on puffing. The steps between primary action of ecdysone and its activation of some specific puffs do not appear to include synthesis of new protein.

451 Emmerich, H., Schmialek, P. DIE LOKALISATION CANCEROGENER KOHLENWASSERSTOFFE IN DER SPEICHELDRÜSE VON Drosophila hydei. (The localization of carcinogenic hydrocarbons in the salivary gland of Drosophila hydei.) Expl Cell Res. 43, 1 (1966) 228-231. (In German)

D. hydei were raised on food containing one of the following ^{3}H-labelled hydrocarbons: the carcinogens, 3,4-benzopyrene, 7,12-dimethylbenzanthracene, and 3-methylcholanthrene and the non-carcinogen, anthracene. The distribution of the radioactivity in the salivary glands was determined after 18 d by normal fixation with ethylene glycol and 10% Cl_3CCO_2H and subsequent autoradiography. The radioactivity of anthracene was evenly distributed in the cells, whereas that of the carcinogenic hydrocarbons was significantly localized to the giant chromosomes; the activity per unit area of the chromosomes was more than twice that of the cytoplasm. The binding of the carcinogenic hydrocarbons was rather loose. (CA 65: 1966, 20569d)

452 Eschrich, W. BIDIREKTIONELLE TRANSLOKATION IN SIEBRÖHREN. (Bidirectional translocation in sieve tubes.) Planta 73 (1967) 37-49. (In German)

The honeydew of aphids feeding on the horizontally fixed stem of a Vicia faba plant was collected on a turning table. When the leaf below the pierced stem was provided with fluorescein, and the leaf above with a ^{14}C-compound, the honeydew mostly contained both tracers. It could be shown that the attractive force of a single aphid is not strong enough to change the direction of transport. The tracers must have moved bidirectionally in the same bundle and joined each other in the sieve tube before it was pierced by the aphid. There exists either a bidirectional movement in the single sieve tube, or the tracers move side by side in a "homodromous loop-path". (Auth.)

453 King, R.C., Aggarwal, S.K. OOGENESIS IN Hyalophora cecropia. Growth 29 (1965) 17-83.

Briefly, data are presented bearing on oogenesis in H. cecropia and some related moth species, and various aspects of the comparative oogenesis of these lepidopterans with Drosophila and other muscoid Diptera are discussed. Attention is drawn to the contrast between H. cecropia and D. melanogaster with respect to the importance of the transfer to developing oocytes of proteins synthesized outside the ovary. Some of the studies cited utilized radioisotopes.

454 Kloft, W., Schulze, E.-F. VERWENDUNG VON TRITIIERTEM WASSER (THO) ZUR FORTLAUFENDEN REGISTRIERUNG DES TRANSPIRATIONSVERLAUFES BEI INSEKTEN. (Use of tritiated water (THO) for continuous registration of insect transpiration.) Atompraxis 13, 6 (1967) 265-268. (In German, with English and French summaries)

Continuous registration of insect transpiration had not previously been possible. After application THO mixes with normal body water and is therefore released simultaneously by the transpiring insect. Continuous measurement and registration are possible by means of an ionization chamber of 100 cm^3 capacity and a vibrating-reed electrometer with attached recorder. To reduce the memory effect the inner surface of the chamber is gold-plated. Environmental factors influencing insect transpiration, e.g. temperature, air humidity, and wind velocity, can be varied in this apparatus. This method permits the course of transpiration to be followed qualitatively over an extended period as well as to detect spontaneous regulating effects. (Based on auth. summary)

455 Marcuzzi, G., Degasperi, P. APPLICATION OF THE AUTORADIOGRAPHIC TECHNIQUE TO THE STUDY OF THE EXCRETION IN THE COLEOPTEROUS INSECT Tenebrio molitor L. p.127-129 of "Proceedings of the Symposium on the Preparation and Bio-Medical Application of Labeled Molécules. Venice, Italy, 23-29 Aug. 1964". Sirchis, J., Ed. Brussels, EURATOM. Dec. 1964, 500 p. EUR 2200.e, European Atomic Energy Community, Brussels (Belgium).

The potassium salt of benzylpenicillin-^{14}C was used, with a mol. wt of 372, and a specific activity of 66.6 μCi/mg. The penicillin was diluted in distilled water and then injected (5.5 μl of solution or 7.5 μg of 0.5 μCi activity) into larvae. The larvae were dissected after 24, 48, 72, 98 or 168 h, and the Malpighian tubules extracted and autoradiographed. Penicillin was found to be eliminated by a process of passive diffusion, perhaps reinforced by secretion when the substance is much diluted in the haemolymph. Accumulation could be demonstrated in the hind-gut. The proximal portion of the tubules proved most active. This was associated with localized alkaline phosphatase. All Malpighian tubules function equally.

456 Martoja, R. DEUX EXEMPLES D'APPLICATION DES RADIOISOTOPES A L'ETUDE DE LA NUTRITION DES INSECTES. Bull. Soc. zool. Fr. 98, 4 (1964) 476-477.

Utilisation des sulfates par les Orthoptères. Urée dans l'alimentation des Grillons. (Bull. sign. biol. physiol.) (See also III/37)

457 Riddert, D. DIE POLYTÄNCHROMOSOMEN DER BORSTENBILDUNGSZELLEN VON Calliphora erythrocephala UNTER BESONDERER BERÜCKSICHTIGUNG DER GESCHLECHTSGEBUNDENEN STRUKTURHETEROZYGOTIE UND DES PUFFMUSTERS WÄHREND DER METAMORPHOSE. (The polytene chromosomes of the bristle-forming cells of Calliphora erythrocephala, with special reference to sex-linked structural heterozygosis and the puffing pattern during metamorphosis.) Chromosoma 21, 2 (1967) 296-344. (In German, with English summary)

Review article. Evidence from autoradiographic studies is cited.

458 Sacktor, B., Childress, C.C. METABOLISM OF PROLINE IN INSECT FLIGHT MUSCLE AND ITS SIGNIFICANCE IN STIMULATING THE OXIDATION OF PYRUVATE. Archs Biochem. Biophys. 120, 3 (1967) 583-588.

Mitochondria from flight muscle of the blowfly, Phormia regina, oxidize proline with a $Q\,O_2$ of 130, a rate that accounts for the rate of utilization of the amino acids during flight. Respiratory control and ADP:O ratios for the flavoprotein-catalyzed oxidation of proline are less than 2. Oxidation of proline generates Δ'-pyrroline-5-carboxylate, glutamate, and subsequently intermediates of the Krebs cycle. Proline, but not glutamate or malate, stimulates oxidation of pyruvate. Flight muscle mitochondria are permeable to proline, α-glycerophosphate, and pyruvate, but not to glutamate and

substrates of the citric acid cycle. These findings suggest that proline enhances the rate of pyruvate metabolism by penetrating the mitochondrial barrier, forming intramitochondrial precursors of oxaloacetate, and effecting the complete oxidation of pyruvate via the Krebs cycle at a maximal rate. It is suggested that a similar mechanism may be operative in vivo to explain how the limitations of pyruvate oxidation, found at the initiation of flight, may be relieved. - Sodium pyruvate-2-^{14}C and proline-$^{14}COOH$ were used. Radioactivity was measured in a Tri-Carb liquid scintillation counter after $^{14}CO_2$ was trapped in hyamine hydroxide and added to 10 ml of toluene containing 0.01% POPOP and 0.4% PPO.

459 Steele, W.F. OXIDATIVE PHOSPHORYLATION AND RELATED REACTIONS IN PARTICULATE FRACTIONS FROM INSECTS. Diss. Abstr. 27, 1 (1966) 89-B.

Oxidative phosphorylation and related reactions, particularly as affected by 2,4-dinitrophenol (DNP), were studied with mitochondria and submitochondrial particles isolated from the flight muscle of the blowfly (Phormia regina) and house fly (Musca domestica). In the presence of a phosphate acceptor, the mitochondria oxidized pyruvate rapidly, and this was tightly coupled to phosphorylation. Added succinate and other citric acid cycle intermediates were not readily oxidized by the intact mitochondria. However, submitochondrial particles coupled succinate or NADH oxidation to phosphorylation, but did not utilize pyruvate. The substrate specificity of intact mitochondria appears to be related to a membrane permeability barrier. Pyruvate oxidation was stimulated by DNP, but only in the presence of ATP(1) (or ADP(2)) and Pi. DNP inhibited the ATP-Pi(3) exchange reaction and promoted ATP hydrolysis with no substrate present. However, with sufficient ATP and Pi-^{32}Pi added, little or no net ATP hydrolysis occurred when pyruvate oxidation was stimulated by DNP, and $AT^{32}P$ continued to be formed. The ATP (or ADP) and Pi requirements are due to their need in substrate-level phosphorylation because DNP still promoted respiration (in the presence of ATP, ADP, and Pi) after coupled phosphorylation and DNP-ATPase were completely inhibited by oligomycin. In the presence of oligomycin, DNP stimulated respiration, with ATP and Pi added, only when sufficient $MgCl_2$ (2 mM) was present to provide ADP for substrate-level phosphorylation. $MgCl_2$, however, did not promote respiration in the presence of oligomycin and in the absence of DNP, and $MgCl_2$ was not essential when ADP was present. These findings show that ATP (or ADP) and Pi are not obligatory in the basic mechanism by which DNP promotes electron transport in insect mitochondria; they also show that DNP can 'release' respiration at all three sites of coupled phosphorylation in the presence of oligomycin. However, at 0.1-0.15 mM DNP, maximal respiratory stimulation was obtained only in the absence of oligomycin, when DNP could promote ATP hydrolysis and uncouple phosphorylation. $AT^{32}P$ formation from oxidative phosphorylation was demonstrated in experiments in which respiration was stimulated nearly maximally by 0.1 mM DNP in the presence of ATP and Pi-^{32}Pi. Other experiments, which utilized ADP, or ATP and hexokinase, as a phosphate acceptor, indicated that the equivalent of two phosphorylation sites were not completely uncoupled by 0.1 mM DNP, since P/O ratios significantly greater than 1 were obtained with short incubation periods, even when the phosphate acceptor was not added until 10 min after the DNP. These results suggest that DNP does not 'release' respiration equally at each of the three sites of coupled phosphorylation. - In contrast to mitochondria, sonic or digitonin particles did not show ATP-Pi exchange or DNP-ATPase activity. Sonic particles coupled succinate or NADH oxidation to phosphorylation with P/O ratios between 0.2 and 0.8; the phosphorylation was inhibited by oligomycin and uncoupled by DNP. Therefore, DNP can uncouple respiration in one or more reactions that do not necessarily lead to ATP hydrolysis. Mg^{++}-ATP-ase was observed with both mitochondria and particle preparations. - At 0.4 mM, DNP caused complete inhibition of pyruvate oxidation and coupled phosphorylation with mitochondria, but did not inhibit succinate or NADH oxidation with sonic particles, although it did uncouple phosphorylation completely. (DA)

(1) adenosine triphosphate.
(2) adenosine diphosphate.
(3) inorganic phosphorus.

460 Sun, A.Y.K. EVIDENCE FOR A SOLUBLE HIGH ENERGY INTERMEDIATE OF OXIDATIVE PHOSPHORYLATION IN MITOCHONDRIA FROM BLOWFLIES. Diss. Abstr. 28, 2 (1967) 516-B.

Studies with whole mitochondrial or submitochondrial particles indicated the presence of a soluble non-phosphorylated high energy intermediate of oxidative phosphorylation. The formation of this

intermediate was dependent on the operation of the respiratory chain and some disruption of the mitochondrion released the intermediate to the incubating medium. The ability to form $AT^{32}P$ in the presence of $^{32}P_i$* and ADP or glucose-6-phosphate ^{32}P (G-6-^{32}P) when a hexokinase trap was used has been used to detect the existence and amount of the high energy intermediate as well as the activity of the transfer reaction in the supernatant fraction. The high energy intermediate released to the supernatant fraction was proteinaceous, resistant to dialysis and survived ammonium sulfate fractionation and acetone treatment. Succinic thiokinase activity was measured by observing $^{32}P_i$-ATP exchange in the presence of succinate and CoA. Attempts to separate exchange activity from the transfer activity were unsuccessful yet the difference in response of these two reactions to inhibitors indicated that the two processes were distinct. It was concluded that in the presence of hexokinase the stimulation of transfer activity by succinate and CoA was not due to thiokinase mediated activity. The succinate-CoA stimulated transfer reaction showed the following characteristics: (i) GDP cannot substitute for ADP. (ii) The rate of transfer reaction was dependent on the concentrations of Mg^{++} and P_i. (iii) Transfer activity was not inhibited by DNP, while oligomycin was slightly inhibitory as was hydroxylamine. Arsenate was the most active inhibitor observed. The high energy non-phosphorylated intermediate has been shown to energize the energy-dependent reduction of TPN^+ by DPNH coupled to the reduction of DPN^+ by succinate. The reaction required soluble fraction, sub-particles, succinate, DPN^+, TPN^+. ATP showed little effect. Arsenate inhibited the reaction probably due to the uncoupling of some of the intermediate. The further competitive effect for high energy intermediate has been shown by the addition of P_i and ADP resulting a low reaction rate in energy-dependent reaction. On the basis of experimental results obtained in this study schematic representation of the energy transfer reaction sequence and the sites of inhibitor action was proposed. It was suggested that the primary non-phosphorylated high energy intermediate acyl~X was present in the soluble fraction. Addition of CoA would lead to the formation of a secondary high energy intermediate of the enzyme bound acyl~S type. (From DA)

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* P_i = inorganic phosphorus.

461 Treherne, J.E. "The Neurochemistry of Arthropods". Cambridge, University Press. 1966, 158 p.

The book deals with the organization of the arthropod nervous system, the water content of nervous tissues in arthropods, inorganic ions, the ionic basis of electrical activity, energy expenditure, carbohydrates, amino acids and proteins, acetylcholine, and other possible transmitter substances. Numerous studies in which radioisotopes had been used are cited in the text, particularly in the chapter on acetylcholine.

462 Van Der Geest, L.P.S., Craig, R. BIOCHEMICAL CHANGES IN THE LARVAE OF THE VARIEGATED CUTWORM, Peridroma saucia, AFTER INFECTION WITH A NUCLEAR POLYHEDROSIS VIRUS. J. invertebrate Path. 9, 1 (1967) 43-54.

Nuclear polyhedrosis virus infection causes a decrease of approx. 20-30% in the total solids content of the haemolymph of P. saucia. This decrease is partially caused by a decrease in protein concentration and in total free amino acids during the disease, although glycine is much higher in diseased larvae. Infection causes an increase in the activity of glutamic-oxalacetic acid and glutamic-pyruvic acid transaminases but not leucine-pyruvic acid transaminase which is very low in both healthy and diseased larvae (Martignoni and Milstead, J. Insect Pathol. 6: 1964, 517). Radioactive amino acids were injected into the haemolymph and the ratio of labelled keto acid to labelled amino acid was used as an index of transaminase activity in vivo. Infected larvae show a higher concentration of keto acids and the index ratio was higher in the case of glutamic acid and leucine but not glycine. (CA 66: 1967, 113400 m)

463 Winteringham, F.P.W. METABOLISM AND SIGNIFICANCE OF ACETYLCHOLINE IN THE BRAIN OF THE ADULT HOUSEFLY, Musca domestica L. J. Insect Physiol. 12 (1966) 909-924.

Methods are described for the determination of [^{14}C] acetylcholine formed in the head tissues of the adult house fly in vivo following [^{14}C] acetate injection. [2-^{14}C] anhydrous sodium acetate and [carboxy-^{14}C] acetylcholine chloride were used. Acetylcholine estimated radiometrically and that assayed pharmacologically were in good agreement. This confirms that this ester largely, if not entirely, accounts for the pharmacological activity of head extracts as assayed with the frog

rectus abdominis muscle preparation. The data indicated that the acetylcholine content of the brain is due to a steady state of synthesis and hydrolysis with a min. turnover rate of 6.1×10^{-5} µM acetylcholine/min/head. Turnover was apparently reduced in insects poisoned with acetylcholinesterase inhibitors. These and other observations are interpreted as showing that the ACh system of the brain is highly compartmentalized, synthesis from choline and intracellular acetate being controlled by the availability of choline arising from acetylcholinesterase action. No correlation was found between acetylcholine turnover in vivo and the incidence of light on the compound eye. Turnover was apparently unaffected by surgical elimination of possible nerve activity originating in the thoracic ganglion. It was, apparently, reduced during cyclopropane anaesthesia. Current problems of insect neurophysiology are critically discussed. - The effects of cyclopropane anaesthesia and/or dieldrin poisoning on [^{14}C] acetylcholine formation were also investigated.

See also, under the headings indicated:

OOGENESIS

92 Glycogen accumulation during oogenesis and its premature release by blocking of the RNA supply. (Study on Musca domestica L.) (Engels, W. et al., 1967)

146 The course of protein and carbohydrate synthesis during oogenesis in Apis mellifica L. (Engels, W., 1965)

265 Nucleic acid metabolism during oogenesis in crickets, Gryllus bimaculatus. (Durand, M. et al., 1966)

417 Oogenesis, the growth of giant cells. (Bier, K., 1967)

418 Structure and function of oocyte chromosomes and nucleoli and extra-DNA during the oogenesis of panoistic and meroistic insects. (Bier, K. et al., 1967)

EMBRYOGENESIS AND DEVELOPMENT:

281 Ribonucleinsäuren in der Embryogenese von Acheta domestica L. (Hansen-Delkeskamp, E. et al., 1967)

311 Insect embryogenesis: macromolecular synthesis during early development. (Lockshin, R.A., 1966)

131 Amino acid and protein metabolism in insect development. (Chen, P.S., 1966)

132 Studies on the haemolymph proteins of the blowfly Phormia regina - changes in ontogenetic patterns. (Chen, P.S. et al., 1966)

229 Control of a sex-limited haemolymph protein by corpora allata during ovarian development in Periplaneta americana. (Thomas, K.K. et al., 1966)

245 Structure and genetic activity of the DNA mass in evidence during germ cell development. (Bier, K. et al., 1966)

252 Synthesis of ribonucleic acid and histone change during spermatogenesis in the grasshopper Chortophaga viridifasciata. (Claypool, C.J., 1967)

278 Developmental variation in the uptake of a RNA precursor by Drosophila virilis salivary glands. (Greenberg, J.R., 1967)

297 Nucleic acid synthesis during insect development. - II. Control of DNA synthesis in the cecropia silkworm and other saturniid moths. (Krishnakumaran, A. et al., 1967)

298 Regulation of gene action in insect development. (Kroeger, H. et al., 1966)

313 Variations in metabolic activity during the larval development of Rhynchosciara. (Mattingly, E.M., 1966)

316 Study of DNase and DNA polymerase activity during Drosophila development. (Muhammed, A. et al., 1966)

317 Deoxyribonuclease and deoxyribonucleic acid polymerase activity during Drosophila development. (Muhammed, A. et al., 1967)

332 Incorporation of uridine and leucine in vitro by Cecropia silkmoth wing epidermis during diapause and development. (Reddy, S.R.R. et al., 1967)

349 RNA, protein, and uric acid content of body tissues of Periplaneta americana (L.) as influenced by corpora allata during ovarian development. (Thomas, K.K. et al., 1966)

MOULTING AND METAMORPHOSIS

79 The behaviour of radiocesium during insect metamorphosis. (Reichel, D.E., 1966)

93a Métabolisme due tréhalose et du glycogène chez le ver à soie, en relation avec la mue, le filage at les métamorphoses. (Florkin, M. et al., 1965)

124 Aspects of the flight metabolism of tsetse flies (Glossina). (Bursell, E., 1966)
170 Biochemistry and mode of action of ecdysone. (Karlson, P., 1964)
262 Larval moulting cycle and DNA synthesis in Drosophila hydei salivary glands. (Danieli, G.A. et al., 1967)
331 Nucleoprotein metabolism in salivary gland chromosomes of Sciara during pupation. (Rasch, E.M. et al., 1967)
355 DNA synthesis and hormonal control of insect metamorphosis. (Williams, C.M., 1965)
375 The biochemistry and metabolism of sterols and isoprenoids in the metamorphosis of the American silkmoth, Hyalophora cecropia (L.) (Goodfellow, R.D., 1966)
411 Organic acids in insects. III. Citrate oxidation and turnover during metamorphosis of the southern army worm Prodenia eridania. (Levenbook, L., 1966)

METABOLISM

124 Aspects of the flight metabolism of tsetse flies (Glossina). (Bursell, E., 1966)
131 Amino acid and protein metabolism in insect development. (Chen, P.S., 1966)
135 Metabolism of monocarbon fragments in insect. I. Incorporation of carbon from ^{14}C formate into certain free amino acids of the haemolymph of Acantholyda nemoralis (Thoms.). (Chmurzynska, W. et al., 1965)
313 Variations in metabolic activity during the larval development of Rhynchosciara. (Mattingly, E.M., 1966)
436 Contribution à l'étude du métabolisme des glandes séricigènes de Bombyx mori, incubées in vitro. (Prudhomme, J.C., 1966)
1738 A multiple unit radiometric respirometer for the measurement of the metabolism of ^{14}C labelled substrates. (Bourke, J.B. et al., 1967)

NUTRIENT REQUIREMENTS

175 Radioisotopes and the determination of nutrient requirements. (Kasting, R. et al., 1966)
470 Study of the nutrition of Myzodes persicae Sulzer by means of ^{32}P. (Cavalloro, R., 1961)

See also under "amino acid requirements" in Subject Index.

SALIVARY PHYSIOLOGY

192 Studies on the salivary physiology of plant-bugs: transport from haemolymph to saliva. (Miles, P.W., 1967)
193 Synthesis of a plant hormone by the salivary apparatus of plant-sucking Hemiptera. (Miles, P.W. et al., 1967)

HAEMOLYMPH CIRCULATION

432 Haemolymph circulation in the dragonfly wing and its suitability as substrate for the parasitic Arrenurus larvae (Acarina, Hydrachnellae). (Münchberg, P., 1963)
433 An illustration, by means of radiotracers, of the way in which haemolymph circulates in the body and appendages of the dragonfly. (Münchberg, P., 1965)
435 Structure of the dragonfly wing and further illustration of its blood circulation by injecting $Na_2{}^{35}SO_4$. (Münchberg, P., 1966)

MUSCLE CONTRACTURE

47 The effects of strontium and other divalent cations on potassium contracture in a locust leg muscle. (Aidley, D.J., 1965)
56 The effect of Ca^{2+} and of fibre elongation on the activation of the contractile mechanism of insect fibrillar flight muscle. (Chaplain, R.A., 1967)

VARIOUS

21 Scintillation counting of tritiated thymidine transferred to females by labelled Drosophila melanogaster males. (Trout, W.E., III., 1966)
440 Macro-autoradiographic study of the distribution and translocation of semen in the female reproductive system of silkworm (Bombyx mori). (Wan-Yuen, C. et al., 1966)

56 The effect of Ca^{2+} and of fibre elongation on the activation of the contractile mechanism of insect fibrillar flight muscle. (Chaplain, R.A., 1967)
79 The behaviour of radiocesium during insect metamorphosis. (Reichel, D.E., 1966)
92 Glycogen accumulation during oogenesis and its premature release by blocking of the RNA supply. (Study on Musca domestica L.). (Engels, W. et al., 1967)
125 The excretion of nitrogen in insects. (Bursell, E., 1967)
145 Gene activation without histone acetylation in Drosophila melanogaster. (Ellgaard, E.G., 1967)
170 Biochemistry and mode of action of ecdysone. (Karlson, P., 1964)
215 Sclerotization in the blowfly imago. (Sekeris, C.E., 1964)
276 Organization of chromosomes in higher forms. (Gay, H., 1964/1965)
285 Study on the structure and function of the lampbrush Y-chromosome in Drosophila. (Henning, W., 1967)
298 Regulation of gene action in insect development. (Kroeger, H. et al., 1966)
323 Chromosome changes induced by infections in tissues of Rhynchosciara angelae. (Pavan, C., et al., 1966)
334 Aspects of structure of polytene chromosome puffs of Drosophila buskii derived from experiments with antibiotics. (Ritossa, F.M. et al., 1963)
224 The biogenesis of leukopterin and its relation to purine metabolism. (Simon, H., 1965)
304 Induction of tissue disorders in insects by alteration of equilibrium factors of pterines-growth hormones, and mechanism of this induction. (L'Helias, C., 1966)
501 Flight range, lengths of gonotrophic cycles, and longevity of ^{32}P-labelled Anopheles stephensi mysorensis. (Quraishi, M.S. et al., 1966)
385 Changes in haemolymph lipoproteins during locust flight. (Mayer, R.J. et al., 1967)
508 Investigations on the radioactivity of honey. (Barabas, B., 1967)

For general "puffing" phenomena see Subject Index.

1.3. ECOLOGY

1.3.1. General Articles. Surveys

OMISSION. Reference should here be made to 467, erroneously listed in the wrong context.
467 Noordink, J.P.W. ENKELE TOEPASSINGEN VON RADIOACTIEVE ISOTOPEN BIJ HET OECOLOGISCH ONDERZOEK. (Some applications of radioactive isotopes in ecological research.) Ent. Ber. 25, 7 (1965) 130. (In Dutch)

See also:

39 Early developments in the use of radioisotopes in agriculture. (Comar, C.L., 1966)
45 Radioisotopes in entomology. (Kansu, A., 1964)
1536 Role of atomic energy in insect study and control. (Huque, H., 1962)

1.3.2. Behaviour

1.3.2.1. Feeding (including Mechanisms of Feeding and Transmission of Food)

464 ERRATUM: This reference should have followed ref. 61.
Espinola, H.N., Capuñay, R., Silva, I.E., da. EFFECTIVE HALF-LIFE OF ^{32}P IN THE SANDFLY Lutzomyia longipalpis (Lutz AND Neiva, 1912) (DIPTERA PSYCHODIDAE). Revta bras. Biol. 26 (1966) 175-179.

Adult L. longipalpis were tagged by rearing the sandflies from the egg stage in a medium containing 100 µCi/g ^{32}P. Two counts of radioactivity were performed to determine the ^{32}P elimination rate, one

just before adult emergence and another on the day of the adult's death. The biological half-life of ^{32}P in the males ranged from the 2nd - 4th day after adult emergence and in the females, from the 5th - 7th day. By using the effective half-life formula it was found that the half-life of ^{32}P in this species was 1.7 - 3.1 d for males and 3.7 - 4.7 d for females. From these data and previous results (cf. ref 7) on the tagging of sandflies with ^{32}P, it was concluded that the ideal dose of ^{32}P for tagging of L. longipalpis was 20 µCi when the tagging was started at the egg stage and 10 µCi when tagging was started at the 4th-larval instar. These conclusions apply only when radioactivity counts are performed with a counter of the same type used in this experiment, or with one of equivalent sensitivity. (From auth. summary)

465 ERRATUM: This reference should have followed ref. 61.
Fairbanks, L.D., Burch, G.E. TURNOVER OF RADIOSODIUM IN Drosophila melanogaster ADULTS OF DIFFERENT AGES. J. Insect Physiol. 12 (1966) 591-599.

The rate of loss of radioactivity from adults of D. melanogaster was observed both in groups and in individual flies of different initial ages ≤ 1176 h and maintained at 25°C. Flies were labelled either by rearing them from the egg stage on media containing ^{22}Na or by feeding adults ^{22}Na in the food media. Even though sufficient equilibration time on the media was allowed and the flies were not anaesthetized after once becoming labelled great variation was found in biologic half-life for flies of all ages. A small but significant association of turnover rate with age was found for the males only. The half-life decreased by 1.8 h for each 100 h of age. The difference between the mean half-life values for males (81.26 h) and females (98.24 h) of all ages combined was statistically significant. The turnover of body Na for a 24 h period was 15.5% and 18.5% for females and males respectively. (Auth.)

466 ERRATUM: This reference should have followed ref. 389.
Monroe, R.E., Hopkins, T.L., Valder, S.A. METABOLISM AND UTILIZATION OF CHOLESTEROL-4-C^{14} FOR GROWTH AND REPRODUCTION OF ASEPTICALLY REARED HOUSEFLIES, Musca domestica L. J. Insect Physiol. 13, 2 (1967) 219-233.

House fly larvae, M. domestica L., were reared aseptically on a synthetic diet containing cholesterol-4-^{14}C as the only sterol source. The uptake of cholesterol by the larvae doubled between 2 and 4 d of age reaching a maxim. of about 10 µg/larva. Cholesterol accumulated in the tissues at a rate that exceeded body weight increase, and the carry-over of larval sterols to the adults was nearly quantitative, confirming the importance of sterol storage in the larval stage. Minor losses occurred prior to pupation, possibly due to gut clearance, and at eclosion with small amounts of sterols remaining in the puparia. The adults were fed on a sterol-free diet to study the utilization of the larval sterols for oögenesis. Sterols were initially incorporated into the eggs at 0.96 µg/mg, but this concentration decreased rapidly with succeeding ovipositions. However, hatchability was not significantly affected until the concentrations reached 0.25 µg/mg. Females that survived several ovipositions lost about two-thirds of their total sterols. Esterification of sterols was very minor during larval growth, but increased appreciably in the pupae and adults and was greatest in the first batches of eggs. Dehydrogenation of cholesterol to 7-dehydrocholesterol was not significant in any stage except the reproducing females and the eggs. The steady decline of total sterols in succeeding batches of eggs was accompanied by a decrease in the percentage of sterol esters and an increase in 7-dehydrocholesterol. (Auth.)

467 ERRATUM: This reference should be in section 1.3.1.
Noordink, J.P.W. ENKELE TOEPASSINGEN VON RADIOACTIEVE ISOTOPEN BIJ HET OECOLOGISCH ONDERZOEK. (Some applications of radioactive isotopes in ecological research.) Ent. Ber. 25, 7 (1965) 130. (In Dutch)

When insects eat little or only food that cannot easily be made radioactive, labelling by ingestion becomes difficult. This problem was avoided in the labelling of the wheat-stem-gall mosquito, Haplodiplosis equestris (Wagn.) by immersing larvae in an aqueous solution of $^{22}NaCl$. After 2 weeks, the radioactivity per larva was 1000 cpm. Gradual deeper penetration of the larvae into the soil at decreasing temperatures could be traced without disturbing the soil structure by measuring the emitted γ-radiation with a normal GM counter. At a temperature of -0.2°C most larvae were found at a depth of 11 cm. Seven thousand larvae were similarly labelled with ^{22}Na, and used to investigate the dispersion of adult insects. Of 7000 larvae, 41 labelled mosquitoes were recovered in traps. Egg bundles also showed radioactivity. The immersion technique, using ^{32}P and ^{22}Na, did not work with larvae of the onion maggot (Hylemya antiqua). Treatment for only 24 h killed 80%

of the larvae. The insect can, however, be labelled very effectively by adding the isotope to a 50% honey solution. – Before the sterile male technique can be applied the population density of the insect must be investigated, a stage of research at which radioisotopes can play an important role. In experiments with Bacillus thuringiensis preparations, ^{32}P was added to the medium in order to check quantitatively the food uptake by third-instar larvae of Pieris brassicae during a certain period. The presence of several toxic substances could be demonstrated in the medium, and are shown in a graph. The inhibiting action of one toxic substance on the appetite of the larvae was also demonstrated graphically. – Finally, some examples are given of the use of a track emulsion to detect very small quantities of an isotope.

468 Pershad, S. ANALYSE DE DIFFERENTS FACTEURS CONDITIONNANT LES ECHANGES ALIMENTAIRES DANS UNE COLONIE D'ABEILLES Apis mellifica L. AU MOYEN DU RADIOISOTOPE P^{32}. Annls Abeille 10, 3 (1967) 139-197.

Les abeilles ont été marquées au ^{32}P (sous la forme $NaH_2{}^{32}PO_4$). Les auteurs ont étudié les échanges trophallactiques entre ouvrières mêmes ou entre différentes colonies et ouvrières-reines, ainsi que les facteurs âge, température, la durée des échanges, le nombre d'abeilles, le métabolisme et la localisation du phosphore.

469 Alibert, J. LA TROPHALLAXIE PROCTODEALE CHEZ Calotermes flavicollis. ETUDE DES RAPPORTS TROPHIQUES UNISSANT ROI, REINE ET LARVES, ET DE LEURS MODIFICATIONS SOUS L'INFLUENCE DE DIVERS FACTEURS. p. 79-92 of "Comptes Rendus du Ve Congrès de l'Union Internationale pour l'Etude des Insectes Sociaux. Laboratoire d'Entomologie de la Faculté des Sciences. Toulouse, France, 5-10 Jul. 1965". (In French, with English summary)

The metabolism of ^{32}P permits measurement of the global intensity of stomodeal, proctodeal and salivary exchanges as well as the determination of the role of different stages of castes in trophallaxis. ^{198}Au, which remains localized in the digestive tract, permits an evaluation of the relative importance of proctodeal exchange in the food relationship among colony members as a whole. 1. Trophic bonds were investigated in some detail. (a) Proctodeal food exchanges between the sexuals of a young colony after the 1st egg laying are frequent and are part of their natural behaviour. When the sexuals get older (3-6 yr) food exchange may be demonstrated by isolating the founder couple from the rest of the colony; however, when again in the presence of ten larvae, both male and female prefer to absorb proctodeal fluid from larvae rather than from each other. (b) In very young colonies, proctodeal exchanges between sexuals and their larvae are rapid and regular. Even though decreasing with the age of the sexuals, they persist at least during the 1st 6 years of the colony. (c) The evolution of the proctodeal feeding of the reproductive couple into one involving saliva is progressive, and depends not only on the age of the sexuals, but also on the number of surrounding larvae. - 2. The relative population density of the society modifies the rhythm of proctodeal trophallaxis as well as regulating the feeding of the couple. - Moulting has a direct influence on bucco-anal trophallaxis. The fluid contents of the rectal pouch, which is extracted when the digestive tract of an individual about to moult is emptied, is recuperated by the other members of the society, which leads to a recrudescence of proctodeal food transfer within the group. - The elimination of the introduced radioisotope by a contaminated donor is considered. The biological half-life of ^{198}Au calculated for a group of termites depends on the composition of the recipient group as well as on the physiological state of the donor larvae. The prolongation of biological half life of ^{198}Au within a group of Calotermes means an intensification of proctodeal exchanges under the influence of these two factors. (Based on auth. summary)

470 Cavalloro, R. INDAGINI CONDOTTE CON ^{32}P SULLA NUTRIZIONE DEL Myzodes persicae Sulzer. (Study on the nutrition of Myzodes persicae Sulzer by means of ^{32}P.) Presented at the "VI Congresso Nucleare. Symposium sulle Applicazioni dell'Energia Nucleare in Agricoltura. Roma, Italia, 15-16 giugno 1961". 11p. (In Italian, with English and French summaries)

The radioisotope part of the study was carried out on the sap which the two forms, the parthenogenetic virginoparous apterous female and the neanide of the exile generation, of M. persicae drawn from the attacked plant. The chemical nature of the groups of substances ingested was investigated by means of electrophoresis and autoradiography, and compared with the substances contained in the plant itself.

471 Cavalloro, R. RICERCA MEDIANTE ^{14}C DELLE CORRELAZIONI TROFICHE TRA AFIDE E PIANTA OSPITE. (Study of the tropic relation between aphids and their host plant by means of ^{14}C.) p. 155-156 of "V Congresso Nazionale di Entomologia, Milano, settembre 1963". (In Italian, with French summary)

The study was carried out on individual aphids (Myzodes persicae Sulzer), particularly on parthenogenetic virginiparaous winged females, on parthenogenetic virginiparous apterous and neanides of the exile generation. All fed on Nicotiana tabacum var. Samsun. Plants were labelled with ^{14}C by maintaining them in a ^{14}CO atmosphere, with subsequent labelling of aphids. By analysing the sap in the aphids and that contained in those parts of the plant on which they had fed various labelled substances could be identified. Particular attention was paid to sugars (polysaccharides, maltose, saccharose, ribose, glucose, mannose, fructose, sedoheptulose), amino acids (alanine, serine, threonine, valine, lysine, hystidine, proline), and organic acids (glycolytic, glyoxylic, glyceric, tartaric, malic, succinic, fumaric, ctric, and acontic). – Tabulated results were presented at the meeting.

472 Chauvin, R., Lecomte, J. ECHANGES PROTIDIQUES ENTRE FOURMILIERES DE Formica polyctena, MESURES A L'AIDE DE RADIO-ISOTOPES. Insectes soc. 13, 1 (1966) 1-4.

Une centaine de grammes de viande de boeuf crue, maigre, et hâchée ont été mélangée avec soin quelques minutes avant son emploi avec 25 mCi de ^{198}Au. Le tout a été déposé sur la fourmilière K (celle qui a donné naissance en quelques années à tout le réseau complexe de fourmilières étudiées). Les échanges de matériel protidique s'effectuent entre fourmilières de F. polyctena de la même manière que les échanges de sucre, tout en restant beaucoup moins actifs.

473 Danneel, I. WEITERGABE VON P^{32}-MARKIERTER SUBSTANZ IM KOERPER VON Aphis fabae Scop. AN IHRE LARVEN (HOMOPTERA, APHIDIDAE). (The transmission of ^{32}P-labelled material in the body of Aphis fabae Scop. (Homoptera, Aphididae) to its larvae.) Z. angew. Zool. 54, 3 (1967) 433-444. (In German)

Of the imagoes which had been ingesting radioactivity with their food for 21.5 h, half were tested while the other half were allowed to feed on non-active saccharine solution for a further 20 h. The large larvae dissected out had an average of 4.1% of the mother's radioactivity. Even after only 1 h, 0.5% was already observed, proving that material had already been transmitted to the larva. It must be remembered that the preparation and decontamination alone already took 10 min, and in addition it cannot be assumed that animals started to feed immediately, once the experiment had begun.

474 Danneel, I. KURZZEITVERSUCHE ZUR NAHRUNGSWAHL VON Aphis fabae Scop. (HOMOPTERA, APHIDIDAE). (Study on food selection of Aphis fabae Scop. (Homoptera, Aphididae) in experiments using short time intervals.) Z. angew. Zool. 54 (1967) 181-182. (In German)

^{32}P was added to the liquid medium, at a specific activity of 2 mCi/ml. At the start, a 18% saccharine solution was offered. The impulse rate was measured by killing the aphid larvae with ether, after feeding. The food was contained between two Parafilm membranes, and the aphids had to puncture the inner one in order to reach the food. Aphids were then placed singly in a precisely defined position, for measuring. For short periods of feeding (4-6 h) the aphids preferred the saccharine solution to the standard diet. For periods of 8-24 h, about equal amounts were taken up. For a 48-h-period, a marked preference was shown for the diet.

475 Duffus, J.E., Gold, A.H. RELATIONSHIP OF TRACER-MEASURED APHID FEEDING TO ACQUISITION OF BEET WESTERN YELLOWS VIRUS AND TO FEEDING INHIBITORS IN PLANT EXTRACTS. Phytopathology 57, 11 (1967) 1237-1241.

Myzus persicae was tagged with ^{32}P by using labelled phosphate, and allowing aphids to feed through natural and artificial membranes. The absorption of plant extracts, the part played by aphids in virus transmission, the significance of the type of membrane used, the colour of the extracts, the concentration of saccharose, and the age and form of the aphid were studied.

476 Ehrhardt, P. ZUR NAHRUNGSAUFNAHME VON Megoura viciae Buckt., EINER PHLOEMSAUGENDEN APHIDE (HOMOPTERA, RHYNCHOTA). (Study of food uptake by Megoura viciae Buckt., a phloem sucking aphid (Homoptera, Rhynchota).) Experientia 17 (1961) 461-462. (In German, with English summary)

The roots of young Vicia faba plants were placed in ^{32}P-labelled phosphate solution (specific activity 0.3 mCi/ml). No food was taken up by the stylets outside the phloem. The aphid stylets are able to penetrate to the phloem at the earliest 7 min after the start of a puncture. Only 3 h later, however, all aphids have reached the phloem. There is a very wide spread in the time taken to reach the phloem. The aphids appear unable to aim and, instead, arrive at the phloem more or less haphazardly. In plants not belonging to the host plants of Megoura viciae the aphid nevertheless also pierces the phloem. The course of food ingestion is studied in relation to the time of sucking, and illustrated by a graph.

477 Hajdu, E., Fairbanks, L.D., Burch, G.E. THE EFFECTS OF INJURY ON THE HUMIDITY REACTION OF Drosophila melanogaster. Physiol. Zoöl. 38, 3 (1965) 197-201.

Radioactivity measurements on flies in contact with a culture medium containing ^{22}Na show that injured individuals feed less than uninjured flies. The first individuals placed in a chamber of variable humidity have a tendency to collect in the most humid zones.

478 Hennig, E. ZUR HISTOLOGIE UND FUNKTION VON EINSTICHEN DER SCHWARZEN BOHNENLAUS (Aphis fabae Scop.) IN Vicia faba – PFLANZEN. (Study on the histology and function of feeding punctures of the black bean aphid, Aphis fabae Scop. on Vicia faba plants.) J. Insect Physiol. 12 (1966) 65-76. (In German, with English summary)

The histology of the feeding punctures of the black bean aphid, A. fabae Scop., the relation between time and depth of the punctures, and their function are investigated. V. faba plants were inserted in a solution of $NaH_2\,^{32}PO_4$ of high activity (16 mCi/ml) for 24 h. Subsequently, wingless virgin aphids were placed on them. In piercing plant tissue the stylets are almost restricted to an intercellular course. Single cells are only rarely penetrated. Such passages are discernible by the bead-like form of the salivary sheath. Near the phloem many tracks are branched. Only the maxillary stylets penetrate the phloem cells. During sap ingestion they are opened like grabs. The mandibular stylets and the salivary sheath end on the wall of the phloem cell. To reach the phloem of their host plants the aphids need 30 - 60 min on an average. Before that the puncture place is often changed once to several times. Mechanical resistance of the plant tissue or lack of room to move the stylets may be the reason for this behaviour. No sap is ingested for nutrition from epidermis or parenchyma. To what extent sap ingestion from these tissues is of importance for taste orientation has not been determined.

479 Kloft, W. RADIOÖKOLOGISCHE UNTERSUCHUNGEN AN FORMICIDEN DES WALDES. (Radioecological investigation of forest Formicidae.) Wiss. Z. tech. Hochsch. (Univ.) Dresden 16, 2 (1967) 582-583. (In German)

Applications of radioisotopes to exchanges (food and other substances) between ants are indicated briefly (by author and year but without bibliographical citation). Experiments on Formica colonies are described aimed at determining whether food exchanges take place between different nests. Total labelling of a whole nest with sufficient quantities of ^{32}P or ^{131}I administered in honey solution leads to a transfer of considerable radioactivity to a series of nests of a colony in various directions up to 200 m. In artificially placed colonies, each consisting of nests of different ant origin, it was found that the new nests became integrated within a few weeks. A colony is thus a nutrition-physiological unit. Studies on the nest-area limits of wood-destroying Camponotus ants showed that within 24 h of tracer application it had become distributed over the entire nest area. Such an area may involve up to 12 stems or an area of 130 m, with passages in the roots. The significance of such passages for further infestation is obvious. Other applications of tracers to such processes as transpiration and respiration are discussed.

480 Kollmann, R. LOCALIZATION OF THE FUNCTIONING SIEVE CELLS IN SECONDARY PHLOEM TISSUE OF Metasequoia glyptostroboides. Planta 65, 2 (1965) 173-179. (In German)

Two to 3-yr-old twigs of M. glyptostroboides on a healthy tree in the field were fed $^{14}CO_2$ in October when cambial activity had begun. Movement of labelled materials was followed by a counting-window tube applied directly to the twig 50 cm below the feeding site. Up to 5 h after feeding, the twig was cut from the tree and plunged directly into liquid N. The frozen specimen was transferred to a cold chamber that contained a microtome and 12-15 µ longitudinal and transverse sections were cut at -20°C. The frozen sections were laid on paper strips on microscope slides and covered with other

slides to which were fastened autoradiographic film. The assembly was fastened together with rubber bands and held 1 to several weeks at -20°C. Before development, the 1st slide and its paper cover were removed and the sections fixed to the film by pouring over them a quickly-hardening 10% gelatin solution. An aphid (Cinara larvicola) that prefers larch could be made to parasitize these twigs and, by the same freezing and autoradiographing technique, the puncture by the insect's stylus was followed. Radioactivity was found only in the region of the youngest phloem cells adjacent to the cambium and the aphid punctures penetrated to this region also. (CA).

481 Krafft, B. SUR UNE POSSIBILITE D'ECHANGES DE SUBSTANCE ENTRE LES INDIVIDUS CHEZ L'ARAIGNEE SOCIALE Agelena consociata Denis. C.r. hebd. Séanc. Acad. Sci. 260, 20 (1965) 5376-5378.

Une Agelena marquée au phosphore radioactif ne transmet pas cette substance à ses congénères, sauf si l'on présente à la colonie une proie neuve qui est consommée en commun. Alors le mélange des sucs digestifs à l'intérieur de la proie aboutit à l'échange indirect de matière radioactive entre l'araignée et les autres. (Aut.)

482 Lamb, K.P., Ehrhardt, P., Moericke, V. LABELLING OF APHID SALIVA WITH RUBIDIUM-86. Nature, Lond. 214 (1967) 602-605.

Results obtained here indicate that saliva production in Aphis fabae (Scop.) continues for at least 6 h at a constant rate after feeding commences, i.e. does not cease once the phloem tissue has been reached.* Adult and nymphal virginoparae of A. fabae were labelled by feeding a medium containing $^{86}RbCl$ (200-300 µCi/ml for up to 46 h), the uptake being apparently linear with time. ^{86}Rb was readily excreted in the honeydew (11-20% of total activity of aphid/drop), the exuviae (2-8%) and in the offspring (3-4%/newborn nymph). If it is assumed that the radioactivity is uniform throughout an aphid weighing 0.5 mg, the results indicate that saliva is injected into the plant at $0.7\ \mu g/h$, i.e. $0.7 \times 10^{-3}\ \mu l/h$. Because an average salivary sheath in Vicia faba leaves measures $\sim 3.7 \times 10^{-6}\ \mu l$ this suggests that additional fluid saliva is probably injected more or less continuously during feeding. The findings are important for an understanding of the transmission of circulative plant viruses.

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* See Kloft, 1/27, for contrary findings obtained for Myzus ascalonicus with ^{32}P

483 Lange, R. DIE NAHRUNGSVERTEILUNG UNTER DEN ARBEITERINNEN DES WALDAMEISENSTAATES. (Food distribution among workers of a forest ant colony.) Habilitationsschrift, Freiburg Univ. (West Germany). Naturwissenschaftliche-Mathematische Fakultät. 1966. (In German)

Experimental data were obtained in support of the hypothesis that both honeydew (carbohydrate) and insect prey (protein) are necessary food components for the normal maintenance of the social and reproductive life of these species. ^{32}P-labelled honeydew solutions and labelled insect haemolymph were used in the experiments. (See 484)

484 Lange, R. ÜBER DIE NAHRUNGSVERTEILUNG IM WALDAMEISENSTAAT. (Food distribution in a forest ant colony.) Wiss. Z. tech. Hochsch. (Univ.) Dresden 16, 2 (1967) 594-596. (In German)

Work on Formica polyctena by means of radioisotopes is discussed. The food intake consists of honeydew and insect prey. The use of ^{32}P-labelled honeydew and radioactive haemolymph or larvae confirmed the need for both types of food, which prove not to be distributed equally. Two kinds of work, i.e. inside and outside the colony, is carried out, the functional difference between worker ants being determined by differences in oocyte development. Radioactive sugar is essentially distributed to workers with entirely or at least largely degenerated oocytes. Only considerably later will radioactivity be found in animals with well developed oocytes. - The distribution of radioactive haemolymph is very different. Labelled food in the form of a radioactive Scoliopteryx larva was given. Radioactivity was later found preferentially in stages with well-developed ovarial contents. These differences indicate differences in the pathways of carbohydrate and nitrogenous food constituents. Thus, proteins and amino acids are needed specially by the queen, the brood, and workers looking after the queen. Workers in the outer services, on the other hand, are primarily in need of energy, i.e. a supply of carbohydrates.

485 Montagner, H. LE MECANISME ET LES CONSEQUENCES DES COMPORTEMENTS TROPHALLACTIQUES CHEZ LES GUEPES DU GENRE Vespa. Thesis, Nancy Univ. (France). 1966.

The mechanism of food transmission between two wasps in their nest was studied using colloidal gold (^{198}Au) and films of high sensitivity, run at 64 frames/s. The main social implications were investigated. Details of trophallactic contacts were analysed. They follow complex stimulation and responses which give rise to tactile and olfactory inter-communication. The part played by the various stimuli which initiate trophallactic contact was investigated. The antennae of both wasps could be shown to play an important part at the moment at which mandibular contact is established between them. Visual stimuli are not very important but body scent accounts for the mutual attraction which precedes trophallaxis itself. Trophallaxis continues only if both establish and maintain suitable and co-ordinated antennal and palpal stimulation and response. Thus a soliciting worker needs to stimulate, by means of antennal activity, the tactile receptors which lie on the mouth parts of the sollicited wasp. These stimuli provoke food regurgitation, and also a reply in which the antennae of the sollicited worker closely approach the other. Continuity of trophallactic contact depends on a stimulation/response equilibrium, which is itself a function of the quantities of food stored in the crops of the two wasps, and on the evolution of "dominance". Antennal stimuli are innate, but their precision and the subsequent response require some maturity. Exchange of antennal information during trophallaxis accounts for the establishment of a dominance scale, the direction and levels being determined by the stimulation and response efficiency of each wasp. Contact dominance by the soliciting wasp is discussed. The dominance scale affects the division of labour within the nest. Because of fluctuations in this scale this division of labour is hardly ever stable and is a factor of social rather than biological age. With the new queens in autumn, the dominance scale is disturbed, involving fights and often mutilation and death. This accounts for annual colony breakdown in the autumn, when old queens may also be killed. Queens are fed passively but must solicit food in times of stress. Males, due to their anatomy and antennal morphology are not adapted to the sensory contacts of trophallaxis. They obtain food by interposing themselves between workers in trophallaxis, and they also stimulate larvae for their fluid. The social organization in a wasps' nest therefore depends mainly on the efficiency of olfactory and tactile stimuli during trophallaxis, and the establishment or disruption of a dominance equilibrium.

486 Parry, W.H., Ford, J.B. THE ARTIFICIAL FEEDING OF PHOSPHAMIDON TO Myzus persicae: I. INTRASPECIFIC DIFFERENCES EXHIBITED BY THIS APHID ON FEEDING THROUGH A PARAFILM MEMBRANE. Entomologia exp. appl. 10, 3-4 (1967) 437-452.

Strain susceptibilities were compared in conjunction with measurements of uptake over a range of phosphamidon concentrations, using ^{32}P as the feeding indicator. Batches of 20 aphids were fed for 24 h on 10% sucrose containing several concentrations of phosphamidon. Three strains of the aphid M. persicae are described which show constant differences in their ability to feed through parafilm membranes. Two of these strains fed fairly readily through the membranes, but the third fed very little. Of the two strains which fed through the membranes, one was more sensitive to the addition of neutral red and phosphamidon to the diet than the other. This sensitivity was shown by a reduction in liquid uptake which partly accounted for the high LC50 found for this strain. On the basis of the uptake methods used, sucrose was found to be phagostimulatory. An attempt at using the susceptibility of the aphids to phosphamidon as a measure of diet acceptability had a limited success.

487 Rodriguez, J.G., Singh, P., Seay, T.N., Walling, M.V. INGESTION IN THE TWO-SPOTTED SPIDER MITE, Tetranychus urticae Koch, AS INFLUENCED BY WAVELENGTH OF LIGHT. J. Insect Physiol. 13, 6 (1967) 925-932.

The influence of varying intensities and wavelengths of light on ingestion of sucrose solution by T. urticae Koch of known age was investigated. Protonymphs and teneral adult females were fed ^{32}P in sucrose solution * and the amount ingested during a 24-h period was measured. Amounts ingested under varying intensities measured through cheesecloth and wavelengths provided through coloured gelatine filters were compared statistically. Differences in ingestion under various light intensities were not significant, nor were differences under various wavelengths in mites in the protonymph stage. As teneral adults the mites ingested most under green light (533 mμ), with yellow (590 mμ), orange (605 mμ), blue (430 mμ), red (625 mμ), unfiltered white, and black (no transmission) following in that order.

* A 3% sucrose solution containing ~25 μCi ^{32}P/ml was placed on the nutrient pad

Green, yellow, orange, and blue significantly improved feeding over black; green, yellow, and orange were significantly better than red, white, and black. Mites at both stages ingested more feeding upside down in microcages than right side up in micro Petri dishes. No correlation was shown between amount of sugar solution ingested as protonymphs and attainment of the quiescent stage. (Auth.)

488 Sen-Sarma, P.K., Kloft, W. TROPHALLAXIS IN PSEUDOWORKERS OF Kalotermes flavicollis (Fabricius) (INSECTA: ISOPTERA: KALOTERMITIDAE) USING RADIOACTIVE I^{131}. Proc. zool. Soc., Calcutta, 18 (1965) 41-46.

Individual pseudo workers were fed Na ^{131}I in sodium thiosulphate solution, with a specific activity of 1 mCi/ml, through soaked filter paper. The technique is described in detail. By measuring the biological half-life of the tracer substance a high rate of trophallaxis was found to operate among members of a group. This fact seems to explain the mechanism of the "group effect".

489 Wegorek, W., Glogowski, K., Czaplicki, E. INVESTIGATION OF HIBERNATION OF Perillus bioculatus Fabr. TAGGED WITH ^{60}Co. Ekol. pol. 13A, 23 (1965) 451-462.

Investigations were carried out on hibernation in natural conditions of Canadian bug – P. bioculatus Fabr. – the natural enemy of Leptinotarsa decemlineata Say. In these investigations the insects grown in the laboratory and tagged with ^{60}Co were used. Finding of living tagged insects in the spring of 1964 proved the possibility of hibernation of this species in the climatic conditions of Poland. (Auth.)

490 Wilson, O.E., Hunt, G.L., Jr. HABITAT SELECTION BY THE QUEENS OF TWO FIELD-DWELLING SPECIES OF ANTS. Ecology 47, 3 (1966) 485-489.

The movements of queens of Lasius neoniger and Solenopsis molesta were followed visually during nuptial flights and with the aid of radioactive tracers after the flights. During and immediately after the flight, de-alated queens were collected, anaesthetised with CO_2, and marked by placing a drop of solution containing 2.5 mCi of ^{131}I as NaI in 0.5 ml of H_2O on the mesosoma and another on the gaster, care being taken to avoid the spiracles, intersegmental membranes, and appendages. The queens of both species controlled their own direction during the flights, keeping to the preferred major habitat (mowed field) with nearly perfect efficiency. When de-alated queens of L. neoniger were experimentally displaced after the flights to woodland they exhibited a higher frequency of negative geotaxis but were very inefficient at moving out of this unfavourable environment. Displaced S. molesta queens showed no behaviour different from that in the favourable habitat and hence were completely inefficient at further macrohabitat selection. On the other hand, queens of both species choose the microhabitats (the points at which the first nests are excavated) after the flights.

See also:

44 Insect nutrition. (House, H.L., 1962)
55 Data on the accumulation, distribution and elimination of ^{85}Sr, ^{131}I and ^{137}Cs in various insect species. (Cavalloro, R., 1966)
60 Experiments on the absorption and excretion of ^{131}I by Aphis fabae Scop. (Aphidae, Homoptera, Insecta). (Ehrhardt, P. et al., 1967)
144 Ecological and nutritional studies on Coleomegilla maculata: Amino acid requirements of the adults determined by the use of C^{14} labelled acetate. (Atallah, Y.H. et al., 1967)
428 Study of the structure and function of the alimentary tract of Megoura viciae Buckt. (Aphididae, Homoptera), with special reference to food uptake and honeydew excretion. (Ehrhardt, P., 1963)
452 Bidirectional translocation in sieve tubes. (Eschrich, W., 1967)
467 Some applications of radioactive isotopes in ecological research. (Noordink, J.P.W., 1965)
491 Evolution of exchanges between different daughter colonies of Formica polyctena measured by means of radioisotopes, ^{198}Au. (Chauvin, R. et al., 1965)
492 Influence du nid à couvain sur les échanges de nourriture entre ouvrières d'abeilles (Apis mellifica). (Douault, P., 1967)
493 Study of nutritional interchanges in the ant Formica polyctena by means of radioisotopes. (Lecomte, J., 1965)
494 Food transmission within the Cryptotermes brevis colony (Isoptera: Kalotermitidae). (McMahan, E.A., 1966)

526 Radionuclide tracer study of arthropod food chains in a spartina salt marsh ecosystem. (Marples, T.G., 1966)

539 A bioassay to characterize strains and preparations of Bacillus thuringiensis Berliner. (Maas Geesteranus, H.P. et al., 1967)

540 Exudates of germinating spores of Bacillus thuringiensis. (Noordink, J.P.W. et al., 1967)

541 The use of radioactivity for the assessment of dose in bioassays involving bacterial insect pathogens. (Rogers, A.H. et al., 1966)

543 Efficiency of radioisotope transfer in predator-prey systems. (Crossley, D.A., Jr., et al., 1966)

548 Radioisotope measurement of food consumption by a leaf beetle species, Chrysomela knabi Brown. (Crossley, D.A., Jr., 1966)

552 Studies by means of the tracer method of the significance of wood-destroying carpenter ants to forestry. (Kloft, W. et al., 1964)

562 Preliminary data on the elimination rate of iron from Triatoma infestans, determined by means of radioactive iron, ^{59}Fe. (Freitas, J.R. et al., 1960)

563 Quantity of blood ingested in vivo by Phlebotomus longipalpis (Psychodidae) as determined by means of radioactive iron. (Freitas, J.R. et al., 1960)

1744 An improved tube closure for biological tests. (Lippold, P.C., 1966)

1.3.2.2. General Behaviour

See:

11 Location of univoltine Aedes eggs in woodland pool areas and experimental exposure to predators. (James, H.G., 1966)

22 The use of labeled mosquitoes for studying population problems. (Vargas L., 1964)

489 Investigation of hibernation of Perillus bioculatus Fabr. tagged with ^{60}Co. (Wegorek, W. et al., 1965)

490 Habitat selection by the queens of two field-dwelling species of ants. (Wilson, O.E. et al., 1966)

1.3.2.3. Social Behaviour

491 Chauvin, R., Lecomte, J. EVOLUTION DES ECHANGES ENTRE DIFFERENTES COLONIES-FILLES DE Formica polyctena MESUREE A L'AIDE DES RADIO-ISOTOPES. (Evolution of exchanges between different daughter colonies of Formica polyctena measured by means of radioisotopes, ^{198}Au. Insectes soc. 12 (1965) 197-200.

Les auteurs ont marqué à l'aide de ^{198}Au une série de fourmilières de F. polyctena, de juin à octobre 1964. Quelques résultats avaient déjà été obtenu en 1963. Il existe une extraordinaire activité des échanges entre une fourmilière-mère et une fourmilière-fille néoformée. La relative indépendance des échanges et du nombre de fourmis présentes sur les pistes entre K (fourmilière-mère) et K_1 n'existait sans aucune circulation de fourmis nettement décelable en juillet, alors que les échanges étaient pourtant actifs. Ceci pose un problème nouveau, d'autant plus que les échanges allant de K vers K_1 en 1964, sans piste décelable, ont été bien plus actifs qu'en 1963 avec piste: l'augmentation du bruit de fond en 1964 a atteint 700% et seulement 26% en 1963 (95 CPS en K_1 contre 75). Les caractères du système d'échanges interfourmilières paraissent stable d'une année à l'autre: échanges réduits en ce qui concerne K_5 et K_7; mais les échanges $K-K_1$ paraissent en moyenne plus actifs que ceux de K vers K_4, alors qu'en 1963 la tendance était inverse.

492 Douault, P. INFLUENCE DU NID A COUVAIN SUR LES ECHANGES DE NOURRITURE ENTRE OUVRIERES D'ABEILLES (Apis mellifica). C.r. hebd. Séanc. Acad. Sci. 264, 8 (1967) 1092-1095.

Une ruche de Chauvin, d'un cadre mesurant 95 cm de large sur 85 cm de haut, a été utilisée. La population contenait environ 3000 abeilles. Pour le marquage, l'auteur a utilisé l'or 198 à cause de sa période courte (2,7 j) et de son émission γ de 0,411 MeV. La détection de la radioactivité a été faite avec un scintillateur à lecture directe S.R.T. SPP (Ann. de l'Abeille, no. 4: 1960, 317-327). Au cours de chaque expérience une seule abeille a été marquée, en lui faisant ingérer du miel contenant quelques μCi, puis elle était déposée à l'entrée de la ruche. L'évolution de la distribution de la

radioactivité a été étudiée. Après avoir diffusé sur presque toute la surface du couvain operculé, elle s'est accumulée sur une partie du nid et s'est étendue sur une aire contenant des cellules occupées par des larvae en cours d'élevage.- Les études ont montré l'influence certaine du nid à couvain sur les échanges trophallactiques entre abeilles. La présence de la reine ne semble pas jouer un rôle important dans le déterminisme de l'emplacement où ont lieu ces échanges.

493 Lecomte, J. ETUDE DES ECHANGES ALIMENTAIRES CHEZ LA FOURMI Formica polyctena AU MOYEN DE RADIOISOTOPES. (Study of nutritional interchanges in the ant Formica polyctena by means of radioisotopes.) Meded. LandbHoogesch. OpzoekStns Gent 30, 2 (1965) 1029-1034. (In French, with French and Flemish summaries)

Les échanges de nourriture entre les colonies de fourmis Formica polyctena ont été étudiés dans le but de préciser certains points de la biologie de ces insectes dont l'intérêt comme agent de lutte biologique paraît démontré. Ces recherches ont été effectuées à l'aide d'une nourriture sucrée marquée en utilisant comme traceur l'or 198. La courte période de ce radioélément et sa facile détection ont motivé son choix. Au cours des quatre années durant lesquelles des marquages ont été opérés dans le même biotope, il a été possible de faire un certain nombre de remarques. Tout d'abord les échanges n'intéressent pas que des colonies appartenant à la même espèce. A deux reprises, il a été possible d'observer des échanges entre colonies voisines mais appartenant à des espèces différentes. Ensuite, il existe, paradoxalement, une certaine indépendance entre les groupes de travail explorant des territoires différents bien qu'appartenant à la même colonie. A l'intérieur d'un complexe de colonies appartenant toutes à l'espèce F. polyctena, il est possible de constater de fortes variations dans la tendance à échanger de la nourriture et des courants préférentiels qui semblent se retrouver d'une année sur l'autre. Ces différentes observations paraissent très importantes en ce qui concerne l'utilisation des fourmis comme agents de lutte biologique: il semble important de vérifier que les échanges de nourriture animale obéissent aux mêmes lois, grâce à une technique décrite par l'auteur. (Aut.)

494 McMahan, E.A. FOOD TRANSMISSION WITHIN THE Cryptotermes brevis COLONY (ISOPTERA: KALOTERMITIDAE). Ann. ent. Soc. Am. 59, 6 (1966) 1131-1137.

Transmission of food by proctodeal feeding within artificial "colonies" of C. brevis (Walker) nymphs was studied, using ^{57}Co. Donor termites were confined for several days in small yellow-poplar cups which had been soaked in a solution of carrier-free $^{57}CoCl_2$ and dried. (^{57}Co is a γ-emitter with a characteristic radiation of 0.123 MeV and a half-life of 270 d; dosages of the cup termitaries were originally ~20 μc/termitary, and were maintained at that level.) Four different colony densities (25, 50, 100, and 200 termites) and four different intervals of exposure to a single radioactive donor (12, 24, 48, and 96 h) were tested. As expected, the larger the colony and the longer the exposure interval, the more nymphs became radioactive. In the 25-member colony showing the fastest transmission rate, colony saturation reached virtually 100% in 96 h, while the highest percentage reached by a 200-member colony for the same interval was 50%. The average amount of radioactivity per termite decreased significantly with increase in density, but appeared not to be appreciably affected by time. Pellet production by individuals declined significantly with time, but was not significantly affected by density.

495 Medler, J.T., Wagner, R.O. ISOTOPES TO ESTIMATE COLONY SIZE OF Formica cinerea Mayr (HYMENOPTERA: FORMICIDAE). J. N.Y. ent. Soc. 72, 3 (1964) 151-159.

Ants taken from a mound were dipped in 100 ml of water containing 0.1-0.2 mCi of ^{198}Au, ^{131}I, and ^{32}P and then returned to the mound. After 1-3 d ants in a recapture sample were scanned singly with an end-window Geiger-Müller tube to determine radioactive disintegration per min. The colony size was estimated by the Lincoln Index. After preliminary trials, ^{131}I was not used because of ant mortality, and ^{198}Au because of its short half-life. A satisfactory method of using ^{32}P was not developed, largely because of contamination between treated and non-treated ants, and the variable counts given by ants in the recapture sample. Experiments with dipping time, radioisotope concentrations and use of spreader-sticker additives did not materially improve the method. The variability in tagging was related to the difference in sizes of worker ants. (Auth.)

See also:

468 Analyse de différents facteurs conditionnant les échanges alimentaires dans une colonie d'abeilles Apis mellifica L. au moyen du radioisotope P^{32}. (Pershad, S., 1967)

472 Echanges protidiques entre fourmilières de Formica polyctena, mesurés à l'aide de radio-isotopes. (Chauvin, R. et al., 1966)

479 Radioecological investigation of forest Formicidae. (Kloft, W., 1967)

485 Le mécanisme et les conséquences des comportements trophallactiques chez les guêpes du genre Vespa. (Montagner, H., 1966)

552 Studies by means of the tracer method of the significance of wood-destroying carpenter ants to forestry. (Kloft, W. et al., 1964)

1.3.2.4. Dispersal and Migration

496 Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. PACIFIC NORTHWEST LABORATORY MONTHLY ACTIVITIES REPORT, OCTOBER 1966, ON AEC DIVISION OF BIOLOGY AND MEDICINE PROGRAMS. BNWL-353 (Rev.), Nov. 1966, 18p.

Among the variety of studies reported are analysis of the short-term movements of a darkling beetle Pelecyphorus sp. and ^{51}Cr, ^{65}Zn, and ^{59}Fe concentrations in plankton, periphyton, caddis fly larvae, and shiners from the Columbia River.

497 D'Ascoli, A., Gómez-Núñez, J.C. NOTAS SOBRE LOS MEDIOS DE DISPERION DEL Rhodnius prolixus Stål. (Note on the means of dispersion of Rhodnius prolixus Stål.) Acta cient. venez. 17, 1 (1966) 22-25. (In Spanish, with English summary)

Field tests with improved radioisotope tagging technique provided preliminary data on the movement and means of dispersion of R. prolixus. This vector of Chagas' disease occupies two main habitats: palms and human dwellings. ^{60}Co-tagged males were released in a palm grove, in a palm 8 m away from a house, and in one house 4 m apart from another. It was found that in the first location tagged specimens dispersed through the adjacent palms, and moved to the nearby houses in the other two locations. The results suggest that, in addition to other reported means, R. prolixus is able to occupy new habitats by its own locomotion. The data also indicate that movement intensity is closely related to feeding frequency and that arachnids, small rodents and domestic fowl, are predators of R. prolixus. (Auth. summary)

498 Dlabola, J., Taimr, L. SOME RESULTS OBTAINED WITH THE APPLICATION OF THE TRACER METHOD IN INSECT MIGRATION AND DISPERSION STUDIES. Acta ent. bohemosl. 62, 6 (1965) 413-430. (In English)

The result of 4 years' investigation of laboratory and field marking experiments, in studies on the qualities and advantages of ^{32}P for migration, dispersal and other observations on insect displacement are reported. Leafhoppers (Javesella pellucida Fabr.) (in spring migration to new oat fields), bees and bumble bees (Bombus terrestris) (effectivity in the alfalfa field) and Meligethes beetles (dispersal after hibernation) in field conditions were studied. ^{32}P proved very useful throughout. Real maximum distances of displacement cannot be ascertained by radioisotopes with any degree of certainty when high dispersal occurs.

499 Jahn, E., Lippay, H., Weidinger, N., Schwach, G. UNTERSUCHUNGEN ÜBER DIE AUSBREITUNG VON NONNENFALTERN DURCH MARKIERUNG MIT SELTENEN ERDEN. (Study of the dispersal of the nun moth, Lymantria monacha L., by means of rare earths.) Anz. Schädlingsk. 39, 2 (1966) 17-22. (In German, with English, French, and Russian summaries)

The rare earths, Europium and Dysprosium, were prepared in a form which could be sprayed on the moth in the field. These stable nuclides were subsequently identified by neutron activation, a procedure which eliminates problems of contamination, biological half-life in relation to life stages, and of radiological and biological toxicity. Europium was preferred for field work as it was less rapidly eliminated, although Dysprosium is technically more suitable. Nun moths (Lymantria monacha L.) labelled with 1γ of Europium/individual by feeding or injection at the larval stage remained clearly tagged, as did pine spinners (Dendrolimus pini) treated similarly the previous year. Moth labelling proved successful in both laboratory and field trials by spraying with 10 γ Europium /individual; 10γ/individual of Dysprosium also proved effective in the laboratory. Dispersal studies showed that moths covered distances of 2 km.

500 Lindquist, A.W., Ikeshoji, T., Grab, B., Meillon, B. de, Khan, Z.H. DISPERSION STUDIES OF Culex pipiens fatigans TAGGED WITH ^{32}P IN THE KEMMENDINE AREA OF RANGOON, BURMA. Bull. Wld Hlth Org. 36 (1967) 21-37.

Methods are described for radioactive labelling of mosquitoes used in field dispersion studies. Between 60 000 and 70 000 3rd-and 4th-stage larvae were placed in sheet-iron vats (30×24×5 in.), and tap water (17.4 l) was added to each of four vats, together with ground dog biscuits for larval food. Radiophosphoric acid (^{32}P) was added at a concentration of 0.05 μCi/ml of water. It was expected that ^{32}P at this concentration would be adequate to tag various species of mosquito larvae. Preliminary tests with C. pipiens fatigans were made at this concentration as well as at 0.025 μCi/ml and 0.1 μCi/ml of water. The uptake of ^{32}P by the larvae depended on the length of time they were exposed in the water to the radioisotope, also by the number of larvae present, the amount of organic matter in the water, and the type of container used. Because the larvae were of different ages at the start, they showed a variation in the cpm values recorded on the scaler. However, the adult mosquitoes emerging from the treated larvae were tagged sufficiently to give 400 - 1900 for females and 300 - 1300 cpm for males. After release and collection at various field sites, the mosquitoes were killed and examined for radioactivity on a portable 5-decade battery-operated scaler. The scaling unit was a Type 1287 A unit (Dynatron Radio) and the G-M tube Type M X 108/01 with a window thickness of 1.5 to 2.5 mg/cm^2 located in a closed hardwood box. The radioactive tagging method described seemed to be harmless to the mosquitoes and gave excellent results. Radioactive adults emerging under normal conditions from larvae collected in the centre of the Kemmendine Experimental Area did not appear to differ in flight behaviour from radioactive adults released at one time in the centre. Mosquitoes of both sexes dispersed evenly in all directions from the release point. The method yielded valuable data on the daily mortality of adults and on the total mosquito population in the area. (NSA 22 : 1968, 17003)

501 Quraishi, M.S., Faghih, M.A., Esghi, N. FLIGHT RANGE, LENGTHS OF GONOTROPHIC CYCLES, AND LONGEVITY OF P^{32}-LABELLED Anopheles stephensi mysorensis. J. econ. Ent. 59, 1 (1966) 50-55.

Eggs were obtained from several thousand females collected in the experimental area. The emerging larvae were reared and 4th-instar larvae of uniform size and vigour were separated and labelled by placing 15 μCi of ^{32}P in 1.5 l of water containing ~750 larvae. An average count of 4000 and 5000 cpm were obtained per male and female, respectively. Unfed, labelled A. stephensi mysorensis Sweet and Rao, < 24 h old, were released. Both male and female mosquitoes were found to fly 1.8 km overnight. Tagged mosquitoes were captured up to a distance of 4.5 km. The first gonotrophic cycle was completed in 3-4 d and the 2nd in 6-8 d. No tagged mosquitoes were captured later than 9 d after release.

502 Quraishi, M.S., Faghih, M.A., Esghi, N. FLIGHT RANGE, LENGTHS OF GONOTROPHIC CYCLES, AND LONGEVITY OF ^{32}P-LABELLED Anopheles stephensi mysorensis. Archs envir. Hlth 12 (1966) 50-55.

503 Smittle, B.J., Hill, S.O., Phillips, F.M. MIGRATION AND DISPERSAL PATTERNS OF Fe^{59}-LABELLED LONE STAR TICKS. J. econ. Ent. 60, 4 (1967) 1029-1031.

Ticks were placed in a Büchner funnel and exposed to ferrous citrate-^{59}Fe solution by pouring the liquid over them. One minute later, the excess liquid was drawn by vacuum into the vacuum flask beneath the funnel. The same exposure was repeated three times with each group of ticks, using the same solution. Then the ticks were removed from the funnel, placed on absorbent paper, and collected in a test tube by a vacuum apparatus (see ref. I/363). ^{59}Fe-labelled lone star ticks, Amblyomma americanum (L.), were released 25 feet from shaded areas at four sites at Camp Bullis, Texas. The predominant direction of migration was toward and into the shaded areas. The ticks migrated as much as 75 ft in 72 h and a total of 95 ft in 11-12 weeks. A vacuum apparatus was used to handle the radioactive ticks.

504 * Taimr, L., Dlabola, J. RADIOISOTOPES AS TRACERS USED FOR MIGRATION STUDIES OF THE LEAFHOPPER SPECIES Calligypona pellucida F. Acta agron. hung. 12, 3/4 (1963) 321-334. (In English, with German and Russian summaries)

* See III/304, originally cited without abstract.

A technique for labelling with ^{32}P is described, both by immersion and feeding methods. Labelling did not affect the life span. In one experiment 17000 labelled specimens, predominantly male, were released. Migration and dispersal were studied. Larvae were found to be able to overwinter on grass weeds of cereals, and change location and host in the spring. There is apparently very considerable migration and dispersal (~1 km within one week) when the sweeping method becomes unsatisfactory.

505 Deleted.

506 Taimr, L., Šedivý, J., Bergmannová, E., Hanker, I. FURTHER EXPERIENCE OBTAINED IN STUDIES ON DISPERSAL FLIGHT OF Meligethes aeneus F., MARKED WITH P^{32} (COLEOPTERA). Acta ent. bohemosl. 64, 5 (1967) 325-332. (In English)

Dispersal flights of Meligethes were studied during the flowering period of the winter rape. The beetles were marked by the dipping method (into aqueous solution of primary $KH_2{}^{32}PO_4$ with an activity of 92 μCi/ml). This was combined with extemally contaminated rape blossoms (^{32}P, of an activity of 55 μCi/ml). The maximum distance of dispersal flights from the release points, direction of the dispersal flights, selection of host plants, and effects of insecticidal treatment on repopulation of rape fields by migratory beetles were studied. Labelled beetles could be readily detected directly on rape stands by the 10th day after release. Tagged beetles were found 2 h after their release in a meadow surrounded by forest, at 300 m from the release point; 388 beetles were recovered from 34 rape fields. Maximum dispersal flight took place during the first days following release; within 48 h, labelled beetles were found at a distance of 9650 m from the release point. The maximum distance covered was 15750 m. Dispersal flights took place in all directions and were not affected by either the terrain configuration or wind direction. Females migrated the same distance as males. Fields treated with DDT dust were repopulated already on the 2nd day after insecticidal treatment. In DDT aerosol and Melipax (toxaphene)-treated fields labelled beetles were found 6-8 d after treatment. Of the species singly admixed to the labelled Meligethes, radioactive individuals of Ceutorrhynchus assimilis Payk. were caught in the rape fields at a maximal distance of 5900 m.

See also:

4 A practical field method for the recovery of blackflies labelled with phosphorus-32. (Baldwin, W.F. et al., 1966)
5 The present state of the protection of potato against the Colorado beetle in the USSR and the problems involved. (Chigarev, G.A., 1963)
8 Labelling mosquitoes with radio-active iodine, ^{131}I. (Harby, L. et al., 1966)
18 Application of radiophosphorus for the marking of leafhoppers in the study of their migration. (Taimr, L. et al., 1965)
22 The use of labelled mosquitoes for studying population problems. (Vargas, L., 1964)
24 P^{32} tagging and recovery of black flies. (West, A.S., 1966)
30 Effects of tagging amounts of radioactive phosphorus on adults of the oriental fruit moth, Grapholitha molesta (Busck) (Lepidoptera: Tortricidae). (Dustan, G.G., 1966)
550 Activity of honey-bees marked with radioisotopes and moved to fields of lucerne (Medicago sativa). (Haragsim, O. et al., 1965)
551 Comparison of the activity of some geographical races of the honeybee (Apis mellifera L.) on lucerne. (Haragsim, O. et al., 1965)
554 Evaluation of activity of honeybee colonies moved to a lucerne seed field. (Šedivý, J. et al., 1966)
1609 Study on mass breeding and sterilisation of the Mediterranean fruit fly Ceratitis capitata Wied. (Scherney, F. et al., 1967)

1.3.3. Inter-Relations

1.3.3.1. Insect Environment
(Radioactive- and Insecticide-Contaminated Systems, including Deliberate Contamination and Fallout, and Food Chains)

507 Auerbach, S.I. RADIATION ECOLOGY. p. 61-118 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1967". ORNL-4168, Oak Ridge National Lab., Tenn. Oct. 1967, 344p.

Studies were reported, amongst others, on the effects of γ-radiation on the survival of Drosophila populations; the distribution of ^{137}Cs, ^{60}Co, and ^{106}Ru in arthropod food chains in White Oak Lake; the distribution of ^{137}Cs in food chains in forest ecosystems; the distribution of stable Cs, K, and Na in food chains in forest ecosystems; the effects of body size on the metabolic rate of arthropods and insects; the metabolism of ^{134}Cs and ^{42}K in crickets; the effects of body-size and temperature on the metabolism of ^{134}Cs in spiders; and the metabolism of ^{187}W in crickets and milkweed bugs.

508 Barabas, B., Lupsan, V. INVESTIGATIONS ON THE RADIOACTIVITY OF HONEY. Ig., Buc. 16 (1967) 79-83. (In Roumanian)

Studies were conducted to determine the levels of natural and artificial radioactivity in honey collected in various localities in Roumania at various times of the year. Natural radioactivity would be expected to originate from ^{40}K, ^{14}C, and ^{226}Ra, and artificial radioactivity from the fallout nuclides ^{90}Sr and ^{137}Cs. Total activity, β and γ-activity, and ^{90}Sr levels were estimated in 1.5-kg samples of honey ashed at 600°C. For samples collected in 1964 in the following localities: Band (May - Jun.), Toplita (Jul. - Aug.), Caracal (May - Jun.), Brosteni (Jul. - Aug.), Tulghes (Jul. - Aug.), and Barasau (Jul. - Aug.), the artificial and total radioactivities were 109.8, 110.8; 78.0, 81.1; 23.4, 24.3; 490.8, 490.0; 446.2, 462.9; and 300.8, 304.8 pCi/kg fresh weight. The ^{90}Sr contents of the same samples, as pCi/kg fresh wt and pCi/g ash, respectively, for samples from these six localities were: 10.8, 27.0, 9.0, 16.6, 20.5, 30.7; 34.2, 21.4; 40.0, 20.0; and 38.0, 35.8. Thus ^{90}Sr accounted for about 10% of the artificial radioactivity of honey. Data on systematic variation of artificial radioactivity of honey with climate and geographical location must await analyses of ^{137}Cs in honey. On the assumption of a per capita dietary intake of 30 g of honey per day, the daily ingestion of radioactivity from this source would be 9 - 12 pCi/d, a figure well below the permissible limit. (NSA 22: 1968, 15011)

509 Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. PACIFIC NORTHWEST LABORATORY MONTHLY ACTIVITIES REPORT, DECEMBER 1966 (ON) DIVISION OF BIOLOGY AND MEDICINE PROGRAMS. BNWL-370. Jan. 1967, 19p.

The ecology of darkling beetles (including Eleodes hispilabris) in the Hanford area has been studied, particularly the elevational distribution.

510 Bourdeau, P., Cavalloro, R., Myttenaere, C., Verfaillie, G. MOVEMENT OF FALLOUT RADIONUCLIDES IN IRRIGATED ECOSYSTEMS OF THE PO VALLEY ITALY. Hlth Phys. 11 (1965) 1429-1444.

Among insects, the highest levels of radionuclide accumulation, particularly of ^{144}Ce, were found in the adult dragonfly, Sympetrum depressiusculum Sel., which is the only terresterial form studied, the others (Dytiscus marginalis Scop., Hydrophilus piceus L., Notonecta glauca L., Ranatra linearis L.) being all aquatic. The relatively large amount of ^{54}Mn in Ranatra corresponded to a high concentration of stable Mn (0.12% of dry weight). Aquatic insects, fish and frogs had very similar levels. Mollusks had higher levels than fish and aquatic insects, particularly of ^{144}Ce. Levels in animals seemed to reflect habitat and diet. - In 1963 and 1964 in the Po Valley, ^{137}Cs, ^{90}Sr, ^{106}Ru, ^{144}Ce and ^{54}Mn increased in rice until harvest. In grains, most of the ^{144}Ce and ^{90}Sr was in the hull; ^{137}Cs was the most active nuclide in the endosperm. Activities were higher in perennial meadows. Covering flooded rice reduced ^{144}Ce in shoots by 72%, ^{90}Sr and ^{137}Cs by 23-26% and ^{54}Mn by 4%. Draining reduced ^{137}Cs by 19%, but increased ^{54}Mn by 62%. Panicles were similarly affected. Covering reduced all nuclides to a greater extent in meadow than in rice. ^{137}Cs appears to be quite available to rice from flooded soils.

511 California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology. ENVIRONMENTAL RADIATION. p. 72-89 of "Semiannual Progress Report for the Period Ending June 30, 1966". UCLA-12-595, 104p.

Progress is reported in various studies including one on Nevada Test Site radioecology and arthropods.

512 Coleman, D.C., Macfadyen, A. THE RECOLONIZATION OF GAMMA-IRRADIATED SOIL BY SMALL ARTHROPODS: A PRELIMINARY STUDY. Oikos 17 (1966) 62-70.

The reinvasion of radiosterilized soil by micro-organisms was studied, as well as the effect of irradiation on some nutrients in the soil. Cores of litter and soil were placed in polythene bags and irradiated in a ^{60}Co γ-source at either 2.5 or 5.0 Mrad. A few cores were irradiated at 5 Mrad with spent fuel. Analyses of exchangeable ammonium and nitrate were compared for newly irradiated samples, samples which had been in the field for eight weeks after irradiation and inoculation, and unirradiated fresh samples. Several-fold increases in ammonium and nitrate in irradiated cores persisted, with little change, throughout the course of the experiment. The numbers of microarthropods recolonizing irradiated cores were assessed two months after return of the cores to the field. Soil microarthropods recolonized irradiated, inoculated samples in some cases in patterns varying with different species of fungi. Respiration of cores after irradiation was at first lower than, and subsequently higher than, that of unirradiated control cores for a month afterward. The methods described are offered as tools for possible use in more detailed studies of the litter-soil ecosystem. (NSA 21: 1967, 22371)

513 Coleman, D.C. FOOD WEBS OF SMALL MYCOPHAGOUS ARTHROPODS OF A BROOMSEDGE FIELD. "New York Meeting of the Ecological Socley of America, New York, N.Y. Dec. 26-31, 1967". AED-CONF-1967. 396-002. 6p.

^{65}Zn was used to follow the movement of fungal organic matter. Special attention was paid to Geotrichum mycelia. Labelling was essentially the result of adsorption. The microarthropods studied consisted of Acaridei (Tyrophagus sp.), Mesostigmata, and Oribatei (Oppia sp.). The food web study shows that ^{65}Zn is more sensitive for samples of very small mass. No pooling of samples is required. Clearly, only a small amount of a given species of soil fungus or its decomposed portions is consumed by various small arthropods. However, two of the mite species ingested and retained ~20% of the initial fungal specific activity. Refinements of the method are discussed.

514 Crossley, D.A., Jr., Witkamp, M. SOIL BIOLOGY. FOREST SOIL MITES AND MINERAL CYCLING. Acarologia 6 (1964) 137-146. "1st International Congress of Acarology, Fort Collins, Colo., USA, 2-7 Sep. 1963".

Mites and other small arthropods in forest soil exert an influence on the forest ecosystem in several ways. Their feeding processes cause a physical breakdown of fallen leaf litter, and the material passed through their intestines is more susceptible to decay by microorganisms. Fragments of leaf litter become more intimately mixed with mineral soil and are distributed vertically by the feeding activities and vertical migrations of soil mites. The impact of these activities on maintenance of the forest may be assessed by measuring quantities which reflect the functioning of the entire ecological system. Rates of cycling of minerals from tree through litter and soil and back to tree constitute one of the functional measurements which can now be made conveniently by the use of radioactive tracer techniques. In experiments at the Oak Ridge National Laboratory, leaf litter was confined in small (1 dm^2) net bags and placed on the forest floors of pine, oak, and tulip poplar stands. Gross loss of weight and of radioactive isotopes of Cs, Ru, Sr, and Co was then measured at weekly intervals; simultaneously, the succession of soil mites in the bags was followed so that the loss of weight and of minerals could be related to arthropod activities. In other experiments naphthalene was used to exclude mites and other arthropods from experimental plots (1 m^2). Comparisons with control plots showed that, after 1 year, plots without arthropods retained 55% of their leaf litter (by weight) whereas control plots retained 40%. Retention of radioactive caesium by leaf litter was changed also. Plots without arthropods retained 16% of their initial caesium content, as compared to 7.5% in control plots. (Auth.)

515 Crossley, D.A., Jr., Shanks, M.H. ^{106}Ru ELIMINATION BY BROWN CRICKETS (Acheta domesticus). p. 72 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1966". ORNL-4007, Oak Ridge National Lab., Tenn. Oct. 1966, 300p.

^{106}Ru is potentially hazardous in waste disposal areas because of its mobility when released into the environment, its relatively abundant fission yield, and its moderately long half-life. ^{106}RuCl or ^{134}CsCl were supplied to cricket colonies in drinking water for several days prior to measurement of biological half-lives. Following the accumulation phase, crickets were caged separately and counted several times daily at 3 to 6-h intervals. Results suggested similar biological half-lives for longer components of Cs and Ru elimination. Elimination rates and distribution in various tissues are discussed. ^{106}Ru was rapidly cleared from crop and gizzard. Mid- and hind-gut concentrations decreased at rates similar to the whole-body longer components. Cs is known to concentrate in the intestinal walls of orthopterans. However, it was also found distributed among muscle, fat body, and other soft tissues of insects, whereas ^{106}Ru concentrated mainly in the intestinal walls and was not detected in the fat body of Acheta (nor was either radionuclide detected in the integument).

516 Crossley, D.A., Jr. COMPARATIVE MOVEMENT OF ^{106}Ru, ^{60}Co, AND ^{137}Cs IN ARTHROPOD FOOD CHAINS. ORNL-P-3081, Oak Ridge National Lab., Tenn. 1967, 24p. "2nd National Symposium on Radioecology, Ann Arbor, Mich., USA. 15-17 May 1967".

The behaviour of radiocaesium in food chains has been relatively well documented in results of environmental studies and tracer experiments, but little information is available on food chain behaviour of ^{106}Ru. New data from a waste disposal site (White Oak Lake bed) permit comparison of ^{106}Ru and ^{60}Co with the distribution of ^{137}Cs along a terrestrial food chain consisting of soil, herbaceous vegetation, herbivorous arthropods, and predaceous arthropods. Vegetation accumulated ruthenium and cobalt more efficiently than caesium (concentration factors of 0.06 vs 0.02). Herbivores also accumulated relatively more ^{106}Ru and ^{60}Co than ^{137}Cs. Predaceous arthropods had ^{106}Ru concentrations approximately twice those of herbivores, although ^{137}Cs and ^{60}Co concentrations in herbivores and predators were similar. These distributions indicate that ^{106}Ru has a greater food chain mobility than does ^{137}Cs and ^{60}Co, with an increase in concentration of ^{106}Ru in herbivore to predator transfers. Turnover rates (biological half lives) for ^{106}Ru and ^{60}Co were compared with ^{137}Cs turnover rate in one insect species (Acheta domesticus L.), and results are reasonably consistent with the data obtained from White Oak Lake bed. (Auth.)

517 Cruz, A.A., de la, Wiegert, R.G. 32-PHOSPHORUS TRACER STUDIES OF A HORSEWEED-APHID-ANT FOOD CHAIN. Am. Midl. Nat. 77 (1967) 501-509.

Earlier studies with ^{32}P have suggested that the old field ant (Dorymyrmex pyramicus), supposedly a predator and scavenger species, was feeding on horseweed (Erigeron canadensis). This supposition was based on an unusual pattern of ^{32}P uptake in the ant population. The present investigation showed that Dorymyrmex is indeed a consumer of horseweed, accomplished not through herbivory, but instead by tending aphids present on these plants and ingesting honeydew. Ants confined for 7 d to tagged horseweed plants harbouring aphids had over four times as much radioactivity as ants confined on tagged plants without aphids. The study suggests that the rapid rise and subsequent decline of ^{32}P in the ant populations in the field is characteristic of species with this food source. It may be a result of changes in the level of ^{32}P in the phloem sap together with a bias in the sampling caused by collecting ants only from the vegetation. (Aut.)

518 Douault, P. ETUDE DE LA CONTAMINATION EXTERNE DE L'ABEILLE ET DE SON MILIEU PAR UN RADIO-ISOTOPE INTRODUIT DANS LA NOURRITURE. Annls Abeille 9 (1966) 37-45.

L'auteur étudie la pollution externe de l'abeille, celle-ci étant nourrie soit avec un aliment solide (candi à reine) soit avec un aliment liquide (sirop de sucre). Cette nourriture est marquée au moyen de phosphore-32, sous la forme de phosphate de sodium. Les résultats obtenus montrent que, contrairement à ce que l'on pensait, la contamination externe de l'abeille est faible dans les deux cas. La contamination des cagettes dans lesquelles vivent les abeilles pendant toute la durée de l'expérience est également faible. Un examen des différents organes, et en particulier des pattes, montre bien que la radioactivité est localisée à l'intérieur du corps de l'insecte. (Aut.)

519 Douault, P. AMELIORATION D'UNE TECHNIQUE DE RECHERCHE DE LA CONTAMINATION DE L'ABEILLE MARQUEE AU MOYEN D'UN RADIO-ISOTOPE. Annls Abeille 9, 2 (1966) 165-169.

L'auteur décrit une technique facilitant la disposition d'une abeille sous l'élément de comptage d'un détecteur Geiger-Müller du type cloche. Comme isotope il a choisi le phosphore 32 sous forme de phosphate monosodique facilement incorporable à la nourriture. L'abeille est introduite

dans un tube de cellophane d'un diamètre approprié. L'abeille, ne pouvant faire aucun mouvement garde pendant toute la durée du comptage, une position rigoureusement constante. Les deux extrémités du tube sont bouchées par un léger tampon de coton afin de permettre à l'abeille de respirer. A la fin du comptage, l'insecte est récuperé facilement et cette manipulation peut se répéter plusieurs fois sans inconvénient. Cette méthode s'est révelée très intéressante car elle permet d'améliorer les conditions de comptage.

520 Fazio, C. BEES AND RADIOACTIVE ANTS. NOTE. INDICATORS OF RADIOACTIVITY. Agricoltore Ital. 12, 2 (1966) 3-8. (In Italian)

521 French, N.R. REVIEW AND DISCUSSION OF BARIUM. p.557-560 of "Radioecology", New York, Reinhold Publishing Corporation and Washington, D.C., The American Institute of Biological Sciences, 1963.

Isotopes of barium account for a sizable fraction of the activity in fresh fission products. They are readily assimilated by aquatic vertebrates and by invertebrates. They are concentrated by some insects, and perhaps by certain soil invertebrates. Mammals accumulate radiobarium in all tissues, and it is fixed in the bones. Radioactive barium may provide considerable radiation doses on a short-term basis to certain facets of the ecosystem. It is concluded that these isotopes merit increased attention by the radioecologist. (Auth.)

522 Getsova, A.B., Volkova, G.A. ACCUMULATION OF INDIVIDUAL RADIOISOTOPES BY DIFFERENT AQUATIC INSECTS. p.11-16 of "Radioaktivnye izotopy v gidrobiologii i metody sanitarnoi gidrobiologii. (Radioactive Isotopes in Hydrobiology and Methods of Sanitary Hydrobiology), Moscow-Leningrad, Nauka, 1964". Translation: Ref. Zh. Biol. (1964) 24E2.

523 Hooper, F.F., Ball, R.C. BACTERIAL TRANSPORT OF RADIOPHOSPHORUS IN A STREAM ECOSYSTEM. p.535-549 of "Symposium for the Disposal of Radioactive Waste into Sea, Oceans, and Surface Water. Vienna, Austria. 17 May 1966". Vienna, International Atomic Energy Agency, Austria. 1966, 898p.

Escherichia coli cells were cultured in a phosphorus-poor medium containing 25 mCi of ^{32}P. The procedures used allowed virtually complete uptake of the radioactive phosphorus by the cells. Cells were filtered from the medium, mixed with stream water, and released into a small coldwater stream during a 33 min period. In moving downstream approx. 10% of the radioactivity diffused from the bacterial cells and appeared in the water in filterable form. Loss of radioactivity from the water appeared to be chiefly due to the fallout of labelled cells but there was also uptake by filter feeding invertebrates. A small fraction of the ^{32}P released in soluble form by the bacterial cells was taken up by periphyton and aquatic macrophytes. Among the consumer organisms in the ecosystem only four species accumulated ^{32}P that had entered the food chain by way of bacteria. These were the caddisflies (Hydropsyche and Brachycentrus), the snail (Physa), and ammocoetes of the brook lamprey (Lampetra). Other species, including fish, accumulated only small amounts of activity: the quantity was in all cases about that expected if the source had been only the soluble phosphorus released by the bacterial cells. Failure to find important concentrations of radioactivity in any part of the chain or in the environment suggests that E. coli cells effectively disperse radioactive phosphorus and minimize the transfer activity through segments of the food web leading to man. The ecological implications of the low efficiency of the endogenous system for removal of E. coli cells are discussed. (From auth.)

524 Kornberg, H.A., Davis, J.J. FOOD CHAINS IN FRESH WATER. p.383-418 of "Radioactivity and Human Diet", Russell, R.S., Ed. Oxford, Pergamon Press, 1966, 552p.

Concentration of radionuclide content in fish as the result of feeding on radioactively contaminated food is considered. Caddisfly larvae, stonefly nymphs, and chironomid larvae take part in the food chain. The article does not enter into detail over radionuclide accumulation in insects.

525 Marples, T.G. A RADIONUCLIDE TRACER STUDY OF ARTHROPOD FOOD CHAINS IN A Spartina SALT MARSH ECOSYSTEM. Diss. Abstr. 26 (1965) 2392.

The arthropods of the Spartina marsh obtain their energy either by grazing on the marsh grass or by eating the microbial-rich organic detritus that is largely derived from dead Spartina. These two energy sources were labelled with ^{32}P in separate quadrats and the subsequent build up of radioactivity followed

in the arthropod populations sampled by sweeping. Four species of insects were the dominant grazing organisms (1 Orthopteran, 2 Hemiptera, and 1 Homoptera) while two families of Diptera (Dolichopodidae and Ephydridae) included the important insects associated with the detritus complex. The spiders were important carnivores and were obtaining the food energy from both the grazing and the detritus food chains. (DA)

526 Marples, T.G. RADIONUCLIDE TRACER STUDY OF ARTHROPOD FOOD CHAINS IN A Spartina SALT MARSH ECOSYSTEM. Ecology 47 (1966) 270-277.

A study was made of passage of radionuclides through the food chain of terrestrial arthropods after labelling grass and detritus in a salt marsh. The marsh grass was principally Spartina alterniflora. The arthropods of the Spartina marsh obtain their energy either by grazing on the marsh grass or by eating the microbial-rich organic detritus that is largely derived from the dead Spartina. Radionuclides were introduced into the food chain either by ^{32}P-labelling of the living plant or the sediment. The two energy sources were labelled in separate quadrants and the subsequent buildup of radioactivity followed in the arthropod populations. A sampling programme was conducted to obtain arthropods for monitoring the presence of the tracer in the various populations. Four species of insects were dominant grazing organisms (one Orthoptera, Orchelimum fidicinum, two Hemiptera, Trigonotylus sp. and Ischnodemus badius, and one Homoptera, Prokelisia marginata), while two families of Diptera (Dolichopodidae-Chaetopsis apicalis and C. aenea, and Ephydridae) included the important insects associated with the detritus complex. The spiders were the important carnivores and obtained their energy from both the detritus and grazing foods chains.

527 Menhinick E.F. INSECT SPECIES IN THE HERB STRATUM OF A Sericea lespedeza STAND. TID-19136, Savannah River Operations Office, (AEC), Aiken, S.C. 1963, 47p.

Insects inhabiting the herb stratum of a stand of Sericea lespedeza [Lespedeza cuneata (Dumont) G. Don] on the Savannah River Plant, Aiken, S.C., were studied by the sweep sampling method. A total of 479 species were present in 39825 adult insects examined. The most numerous were Orthoptera, Hemiptera, Homoptera, Coleoptera, and Hymenoptera. Numbers of insects were low during the winter, averaging 0.43/m²; and increased to an average of 11.25/m² during the summer. - Since lespedeza is important in the successional stages of old field ecosystems, this list of the insect fauna of the community is a useful basis for other work being carried out on the Savannah River Plant by the Ecology Laboratory. These latter studies have been concerned with estimation of community metabolism by using radioactive tracers and the fate of radioisotopes experimentally introduced into old field ecosystems.

528 Nelson, D.J., Auerbach, S.I., Kevern, N.R., Blaylock, B.G., Martin, R.E., Rosenthal, G.M., Early, R.C., Griffith, N.A. CLINCH RIVER AND RELATED AQUATIC STUDIES. p.107-115 of "Health Physics Division Annual Progress Report for Period Ending June 30, 1963". ORNL-3492, Oak Ridge National Lab., Tenn. 30 Sep. 1963, 245p.

Aquatic studies continue to emphasize the fate and effects of radionuclides released to the Clinch River via White Oak Creek. The transport of ^{90}Sr from the Clinch River by emerging aquatic midges (Chironomidae) was compared with the accrual of ^{90}Sr to the river from weapons-testing fallout. Larval development of the midges occurs in the contaminated river-bottom sediments. Emerging adults were caught in insect light traps operated on the river bank at dusk. Adults in one large, composite sample contained 8.76 times as much ^{90}Sr [$(3.55 \pm 1.13) \times 10^{-6}$ μCi/g of dry weight] as did an equal quantity of river-bottom sediment from the same location. Studies elsewhere have shown that 10 g m^{-2} yr^{-1} may be contained in the emergent insect biomass. These emergent insects would transport $(3.55 \pm 1.13) \times 10^{-5}$ μCi of ^{90}Sr per square meter per year from the river bottom. The average increment of ^{90}Sr from fallout in the United States between 1959 and 1960 was 4.2×10^{-3} Ci/square mile (1.62×10^{-3} μCi/m^2). Thus, fallout entering the river directly would add 45 times as much ^{90}Sr as removed by emerging chironomids. The salivary gland chromosomes of Chironomus tentans larvae collected from White Oak Creek and from six uncontaminated areas were examined for chromosomal aberrations. White Oak Creek populations were exposed to a dose rate calculated as 230 rad/yr, or about 1000 times background. 15 different chromosomal aberrations were found in 365 larvae taken from the irradiated population as compared with five different aberrations observed in 356 larvae from six control populations, but the mean number of aberrations per larva did not differ in any of the populations. The quantitative amount of heterozygosity was essen-

tially the same in the irradiated and the control population, but there was three times the variety of chromosomal aberrations found in the irradiated area. From this evidence it was concluded that chronic low-level irradiation from radioactive waste was increasing the variability of chromosomal aberrations without significantly increasing the frequency. (from Auth.)

529 Osburn, W.S., Jr. RADIOECOLOGY OF THE COLORADO RANGE. Terminal Report. COO-1191-10, Colorado Univ., Boulder, 1964, 173p.

The removal of fallout material from pond water is discussed. The radioactivity of the pond water, always much less than that of the surface scum and snow debris, decreased rapidly during the season. Caddisflies are important primary consumers in most tundra ponds. As would be expected, their radioactivity was quite high. Their rapid drop from nearly 4000 to < 100 piCi/g dry weight during the summer was due to a number of factors. Another drop in activity occurred at pupation. No adults were found. The fact that the caddisfly (Limnephilus)peak burden of radioactivity did not correspond with the peak for water radioactivity shows that these animals obtained their fallout loads somewhat independently of the condition of the pond water. The benthic detritus feeders had a low radioactivity throughout the summer. Occasional samples of Aedes larvae and pupae showed them to be intermediate in activity between the caddisflies and the benthic species. The other free-living species, the beetle Copelatus, showed very low amounts of radioactivity. This beetle forms the highest trophic level in the pond, for it is supposedly exclusively carnivorous. In the case of the ponds studied a general decrease in activity from one trophic level to the next occurred. This was also found true for animal predators of insects (p. 59).

530 Petty, R.O., Williams, E.C., Jr. RATES AND PATTERN OF RADIOISOTOPE RELEASE FROM FRESH TREE LITTER AT THREE LEVELS OF MESIC FOREST DEVELOPMENT. COO-1006-4, Wabash Coll., Crawfordsville, Ind. Dept. of Biology. 1965. 104p.

Findings are summarized from a 4-yr study of the rates and pattern of release of certain radioactive elements from fresh tree litter at three stages of mesophytic forest development. Young saplings of various tree species were inoculated with tracer amounts of ^{137}Cs, ^{32}P, ^{86}Rb, or ^{89}Sr and the activities in leaves, twigs, adjacent soil, and leaf litter were determined after various time intervals. The ecosystems studied included an old field, an oak forest, and a beech-maple climax forest. Records of precipitation and temperature were maintained and a number of related studies were carried out, including a study of secondary uptake of radionuclides by proximal vegetation, a survey of microbial populations in the leaf litter, and the uptake of ^{32}P by insects inhabiting the forests. Ecological implications of the findings are discussed. (NSA 20: 1966, 12566)

531 Pora, E. et al. CERCETĂRI ASUPRA INCORPORĂRII ŞI ELIMINĂRII P^{32} LA UNELE ORGANISME SALMASTRA DIN LACUL AGIGEA SI EFORIE. (Investigation of ^{32}P-uptake and clearance in some brackish organisms of the Agigea and the Eforie Lakes.) Studii Cerc. Biol., Ser. zool. 17, 4 (1965) 329-337. (In Roumanian)

Investigations were carried out at the Agigea marine station, Dubruja Region, during summer 1961 on the following material: Chironomus larvae, Odonata larvae, Corixa geofroy adults, Micronecta minutissima larvae, Cladophora sp. Myriophyllum sp., Potamogeton cardium edule, Ceramium rubrum and Mytilus galloprovincialis. Among these, the most reliable detectors of brackish water radioactivity were: Cladophora sp. occurring in the Techirghiol Lake, Myriophyllus sp. in the Agigea Lake, and Cardium edule in the Eforie Lake. A very high ^{32}P accumulation rate was recorded in algae as against the organisms studied. In higher plants, intense ^{32}P uptake occurred in the assimilation organs. Ionic ratio variations of the water (ionic imbalance) increased ^{32}P uptake and clearance rate, thus allowing for the decontamination of a brackish water basin. (Roumanian Sci. Abstr.)

532 Reichle, D.E. RADIATION PROFILE OF A HERBIVOROUS INSECT. Paper presented at the "11th Annual Meeting of the Health Physics Society, Houston, Tex., USA, 27-30 June, 1966".

The responses of insect populations in irradiated landscapes are important in the function and structural re-stabilization of such natural systems. The consequences of direct radiation insult to populations, as well as secondary effects resulting from flow of radioactive materials through ecosystems depend on an array of factors. A radiation profile was established for the evergreen bagworm, Thyridopteryx ephemeraeformis. Eggs and subsequent age classes of larvae were irradiated with a ^{60}Co γ-source (at 14.4 R/sec), with subsequent determination of LD-50/20d. In addition, field colonies were

maintained in a ^{134}Cs-contaminated forest plot, as a measure of chronic background exposure effects. Radiosensitivity decreased with increasing age of embryonic development. (2-d-old eggs: no hatching after ⩾1600 rad; 12-d-old eggs: > 25 600 rad.) The lethal limits of eggs during early development was ~16 times greater than stages immediately preceding hatching (13-14 d). 1-d-old larvae were 4-fold less radiosensitive than pre-hatch eggs. Greatest sensitivity (from LD-50 values) was at 48 h of embryonic development. Sensitivity progressively decreased through embryogenesis to hatching, and thereafter larvae exhibited an inverse relationship with body size, without significant correlation with age. The ecological significance of greater egg sensitivity is enhanced by the fact that the major portion of the life cycle (October-April) of this species is passed in this state. External γ- and total internal dose delivered to diapausing eggs in contaminated plots were far below any for which effects had been observed.

533 Reichle, D.W., Crossley, D.A., Jr. TROPHIC LEVEL CONCENTRATIONS OF Cs-137, SODIUM, AND POTASSIUM IN FOREST ARTHROPODS. ORNL-P-3065, Oak Ridge National Lab., Tenn. 1967, 21p. "2nd National Symposium on Radioecology, Ann Arbor, Mich., USA. 15-17 May 1967".

In a forest ecosystem experimentally tagged with ^{137}Cs, the trophic dynamic aspects of arthropod food chains are being investigated using radio-tracer techniques. ^{137}Cs concentrations in organisms in isotopic equilibrium with food have shown progressive reduction during dispersion through food chains, although the fractional transfer between food and consumer increased with each successive trophic level. The distribution of other alkali metals in arthropod food chains varied from that of Cs. K concentrations in primary consumers (saprovores) were a factor of 3.5 higher than in detritus, although they decreased (similar to ^{137}Cs) by a factor of 0.5 from primary consumers to predators. Na concentrations in primary consumers increased by a factor of 17 above leaf litter, and by an additional factor of 1.5 in predators. There were no significant differences in ^{137}Cs to K ratios between arthropod trophic levels. Changing elemental composition of litter during decay, nutrient availability and assimilation efficiency by arthropods, and biological half-lives of each element were parameters affecting absolute concentrations and ^{137}Cs to K ratios in each trophic level. - Oral dosing solutions for biological half-life determinations consisted of the chloride salts of ^{134}Cs, ^{42}K, or ^{24}Na dissolved in HCl diluted to 10 μCi/ml in distilled water and neutralized with $CaCO_3$. Young adult crickets, Acheta domesticus, were kept at 27°C during retention experiments.

534 Stern, V.M., Dailey, E.F., Jr. Nevada Test Site - Radioecology - Arthropods. p.86-87 of "Semiannual Progress Report for the Period Ending Dec. 31, 1966". UCLA-12-612, California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology. 105p.

An interim report on research activities is given. Seasonal variations in population density and behavioural patterns are being analysed in studies now being continued on the effects of irradiation on arthropods in the four 20-acre test plots at Rock Valley (Nevada Test Site). - Continuous recordings of soil surface temperature and at 6 and 9 in. below ground level were recorded at Rock Valley as well as wind speed at the 1-ft.-level. Techniques were continued in marking Eleodes armata and several other species. Previously (1965) marked specimens were recaptured in 1966. Studies were also initiated to develop techniques for tagging small arthropods with fluorescent pigments. Intestinal tracts of lizards are being accumulated to give a better understanding of the seasonal role played by arthropods in desert food chains.

535 Wegorek, W., Glogowski, K., Czaplicki, E. POSSIBILITY OF CONTAMINATION OF INSECTIVOROUS GAME BIRDS DURING ECOLOGICAL INVESTIGATIONS USING INSECTS LABELED WITH ^{60}Co. Ochr. Rost. 5, 2 (1963) 19-28. (In Polish)

An evaluation was made of the extent to which various tissues of game birds incorporate radiocobalt from eating insects contaminated with the radionuclide. Muscle, liver, heart, stomach, and blood of pheasants (Phasianus mongolicus) fed Colorado beetles (Leptinotarsa decemlineata) containing ^{60}Co were examined. The birds were fed with different amounts (from 13.0 - 25.0 μCi) of ^{60}Co contained in the insects, and were killed on 6th day after the last feeding. The pheasants excreted about 95% of the fed radioactivity in 3 d, beginning from the time of the last feeding of ^{60}Co-containing insects. The total max. radioactivity per pheasant was 0.084 μCi/kg, and most ^{60}Co was present in liver, heart, and stomach. The specific radioactivity of liver, heart, and stomach greatly exceeded specific activity of trunk, limb, and wing muscles. The results show that treating Colorado beetles with $^{60}Co(NO_3)_2$ for ecological investigations does not contaminate the muscles of game bird in excess of acceptable doses when appropriate measures are observed. (NSA 21: 1967, 6471)

See also:

63 Distribution and effective half-life of cobalt-58 in Habrobracon. (Grosch, D.S., 1965)
68 The uptake of strontium 90 by Chironomus varus. (Jones, T.H., 1967)
83 Effect of EDTA on coefficients of accumulation of various radioisotopes from water solution, by sweet-water hydrobionts. (Timofeeva-Resovskaya, E.A. et al., 1965)
496 Pacific Northwest Laboratory Monthly Activities Report, October 1966, on AEC Division of Biology and Medicine Programs. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab., 1966)
556 Forb-Arthropod food chains in a one-year experimental field. (Wiegert, R.G. et al., 1967)
661 The cycling of Cl-36 labelled DDT in marsh ecosystem. (Meeks, R.L. et al., 1967)
761 Water translocation of diazinon-^{14}C and parathion-^{35}S off a model cranberry bog and subsequent occurrence in fish and mussels. (Miller, C.W. et al., 1966)

1.3.3.2. Insect - Microorganism

536 Corbel, J.C. REMARQUES SUR L'INCORPORATION DE ^{35}S PAR UNE GREGARINE INTESTINALE D'INSECTE ORTHOPTERE. C.r. hebd. Séanc. Acad. Sci., Paris 261, 18 (1965) 3669-3671.

L'étude de la nutrition de Gregarina gamhami Canning (Sporozoaire grégarinomorphe) parasite de Locusta migratoria L. est entreprise à l'aide d'injections de méthionine et cystéine ^{35}S à l'hôte et par l'incubation de Grégariens dans un milieu de survie contenant ces acides aminés. Les mesures de radioactivité sont, après broyage, effectuées sur deux fractions: l'une acidosoluble, l'autre précipitable par l'aide trichlor-acétique. On trouve: (1e) La diffusion de la méthionine dans G. garnhami est rapide. Par contre, l'incorporation de cet acid aminé, ou du ^{35}S dont il était porteur, dans une macromoléeule est relativement lente. (2e) La distribution des zones radioactives des Grégarines après injection du métabolite à l'hôte, est en accord avec celle des radicaux sulfhydriles et disulfures des protéines révélés par les méthodes histochimiques usuelles. (3e) Les stades jeunes incorporent le ^{35}S plus rapidement que les stades âgés. (4e) L'épimérite ne semble pas jouer un rôle primordial dans l'incorporation du soufre. (5e) La fixation du soufre issu de la cystéine est plus intense chez les gamontes femelles que chez les mâles.

537 Donnellan, J.F., Kilby, B.A. URIC ACID METABOLISM BY SYMBIOTIC BACTERIA FROM THE FAT BODY OF Periplaneta americana. Comp. Biochem. Physiol. 22, 1 (1967) 235-252.

Na (1-^{14}C) glyoxylate, (1-^{14}C) glycerate, (2-^{14}C) allantoin, and Na (2-^{14}C) urate were used in the study. The symbiotic bacteria from the fat body of the cockroach were grown on urate in vitro. Uric acid was shown to be degraded through allantoin, allantoic acid, ureidoglycolate, glyoxylic acid, tartronic semialdehyde to glycerate and then through pyruvate and the tricarboxylic acid cycle. The bacteria also contained urease and malate synthetase. Fat body from the desert locust, Schistocerca gregaria, degrades uric acid only to allantoin. This tissue is devoid of symbionts. The significance of urate metabolism by the symbionts is discussed briefly.

538 Halkka, O., Heinonen, L. CHROMOSOME BREAKAGE ASSOCIATED WITH INFECTION. II. STAINED SECTIONS. Hereditas 58, 1-2 (1967) 253-261.

Specimens of the house cricket, Acheta domesticus, and the water scorpion, Nepa rubra, were investigated for chromosome damage caused by certain infecting microbes. The spread of a microbial infection in the spermatogonia and spermatocytes of Acheta and Nepa was investigated, with special reference to cytogenetically significant changes in the chromosomes. Whole testes or ovaries were fixed, stained with Feulgen, embedded and sectioned. A similar procedure was used for thymidine radioautography. Depending on the size of the specimen, 2-5 µl of the ^{3}H-thymidine solution (1 mCi/ml, specific activity 11.9 Ci/mM) was injected into the abdomen. In the case of intracellular infection, host and microbe labels are not easy to tell apart. Radioactivity in the nucleus and even in or at the chromosomes is not necessarily chromosomal. The initial experimental autoradiographic programme involved the use of very variable intervals between injection and fixing: 12, 18, 24, 30, ... 90, 96, and 102 h. Present results are merely preliminary. The metabolic events of spermiohistogenesis are also almost unaffected despite heavy chromosome damage. Sperm nuclei of variable size and deformed, presumably sterile sperm are formed. Cytogenetically most interesting are minor changes

in the chromosomes which follow mild infection ensuing at a late stage of spermatogenesis. Chromatin bridges and laggard chromosomes are common in the anaphases. Nondisjunction of bivalents and chromosomes, formation of tetrapolar cells and cell division without chromosome division occur in the infected cells. In some of the anaphases, partial despiralization of the chromosomes is visible. Such despiralization may indicate defectiveness in the histone component of the chromosomes.
The infective agent, which probably has a DNA genome, does not induce the formation of any diffusible toxins able to inhibit the DNA synthesis of the host. The importance of intracellular microbes as mutagenic agents is stressed. In fact, a considerable proportion of the "spontaneous mutations" may be due to intracellular parasitism. The chromosomal changes observed in Acheta are discussed with reference to the action of an oncogenic virus in Drosophila. Since the microbe responsible in Acheta is probably a rickettsia, the mechanism of chromosomal changes is discussed against the background formed by knowledge of the biochemistry of the action of a related microbe, Mycoplasma.

539 Maas Geesteranus, H. P., Noordink, J. P. W., Van den Anker, C. A. A BIOASSAY TO CHARACTERIZE STRAINS AND PREPARATIONS OF Bacillus thuringiensis Berliner. p. 302-306 of "Insect Pathology and Microbial Control". Van der Laan, P. A., Ed. Amsterdam, North-Holland Publishing Co. 1967, 360p. "Proceedings of the International Colloquium on Insect Pathology and Microbial Control. Wageningen, The Netherlands. 5-10 Sept. 1966".

The authors state that since the cessation of feeding caused in 3rd-instar larvae of P. brassicae by B. thuringiensis occurs when the infected food reaches either the pharynx or the midgut, depending on the preparation used, it is possible, by incorporating ^{32}P into a bacterial preparation and determining the amount of radioactivity in each larva (and hereby the amount of food consumed) after a given period of feeding on leaves treated with progressive concentrations, to obtain information on the composition of the preparation used, and describe the results obtained when this method was applied to three preparations of B. thuringiensis, E (Etalon 61 from the Pasteur Institute), T (Thuricide DS 11412-C) and N (Biotrol BTB 670-048).(From RAE-56:1968, ref. 11)

540 Noordink, J. P. W., Maas Geesteranus, H. P., Van den Anker, C. A. EXUDATES OF GERMINATING SPORES OF Bacillus thuringeiensis. p. 249-250 of "Insect Pathology and Microbial Control". Van der Laan, P. A., Ed. Amsterdam, North-Holland Publishing Co. 1967, 360p. "Proceedings of the International Colloquium on Insect Pathology and Microbial Control. Wageningen, The Netherlands. 5-10 Sept. 1966".

The authors report that in work with 3rd-instar larvae of P. brassicae, germinating spores of B. thuringiensis (of a strain corresponding to serotype I) appeared to produce exudates that caused a marked difference in larval food consumption, and briefly describe paper chromatographic investigations of the exudates carried out with radioactive spores obtained by the use of a culture medium labelled with ^{14}C. (RAE-A 56:1968, ref. 11)

541 Rogers, A. H., White, A. G., Wolf, J., Gibson, N. H. E. THE USE OF RADIOACTIVITY FOR THE ASSESSMENT OF DOSE IN BIOASSAYS INVOLVING BACTERIAL INSECT PATHOGENS. p. 296-302 of "Insect Pathology and Microbial Control". Van der Laan, P. A., Ed. Amsterdam, North-Holland Publishing Co. 1967, 360p. "Proceedings of the International Colloquium on Insect Pathology and Microbial Control. Wageningen, The Netherlands. 5-10 Sept. 1966".

The authors describe a technique for determining the amount of a pathogen actually ingested by a test insect, either individually or in groups, in which a measured quantity of a radioisotope (^{32}P being particularly suitable) is added to a known volume of the preparation of the pathogen, which is then mixed with the insect food, the radioactivity of the latter being determined before and after ingestion by the insect, and give details of the application of this method to the ingestion of spores and crystals of B. thuringiensis by Pieris brassicae, emphasising that the method is also applicable to other insect species, with certain modifications in the case of those that are not leaf-feeders. (From RAE-A 56:1968, ref. 11)

See also:

467 Some applications of radioactive isotopes in ecological research. (Noordink, J. P. W., 1965)
475 Relationship of tracer-measured aphid feeding to acquisition of beet western yellows virus and to feeding inhibitors in plant extracts. (Duffus, J. E. et al., 1967)

1.3.3.3. Insect - Animal
(including Parasite and Predator Relationships)

542 Berendyayeva, E. L. et al. EXPERIENCE OF STUDYING CONTACTS WITHIN A POPULATION OF ALTAI MARMOTS BY MEANS OF RADIOACTIVE TAGGING. Zool. Zh. 45, 3 (1966) 430-435.

Contacts among Marmota m. baibacina were traced by counting tagged fleas from untagged marmots after 30-42 d.

543 Crossley, D. A., Jr., Shanks, M. H. EFFICIENCY OF RADIOISOTOPE TRANSFER IN PREDATOR-PREY SYSTEMS. p. 71-72 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1966". ORNL-4007, Oak Ridge National Lab., Tenn. Oct. 1966, 300p.

Work is reported on the evaluation of food chain transfers of radioisotopes such as ^{137}Cs and ^{90}Sr. Radioisotopes of Cs have been employed to estimate rates of dry-matter movement and energy flow in plant-to-insect transfers. Additional laboratory experiments were initiated to analyse the efficiencies of radiocaesium transfer in predator-prey trophic exchanges. The brown cricket, Acheta domesticus, served as prey species. A laboratory colony received $^{134}CsCl$ in drinking water (1.4 μCi/ml); after 1 week, individuals were removed and offered to predator cages singly. After feeding, radiocaesium accumulation in predators was evaluated by the relation

$$Cs_p = Cs_h - Cs_r - Cs_u$$

where Cs_p = radio-Cs accumulated by predator during a single feeding
Cs_h = radio-Cs in prey at initiation of feeding trial
Cs_r = radio-Cs in uneaten residues after feeding, and
Cs_u = radio-Cs unaccounted for.

Gross predatory efficiencies from the ratio $(Cs_h - Cs_r)/Cs_h$ were tabulated for Tenodera, Otocryptops, and Lycosidae. The mantis, Tenodera sinensis, accumulated ~98% of both weight and radio-Cs. Lycosid spiders were least efficient. A highly efficient accumulation of radio-Cs by predators could be demonstrated.

544 Crossley, D. A., Jr. RADIOACTIVE TRACER MEASUREMENTS OF PREDATION BY ARTHROPODS. Bull. ecol. Soc. Am. 48, 2 (1967) 64-65. Abstr.

Methods previously developed for studying herbivore-plant transfers were applied to arthropod predators and their prey in field areas tagged with ^{137}Cs. Arthropods feeding on prey tagged with radioisotopes reached an equilibrium body burden which was a function of the rate of intake and the biological half-life of the chemical element in the predator. Laboratory experiments demonstrated that predators ingested 90-100% of the radiocaesium in their prey, at least in those transfers where weight ingestion was similarly high. Turnover rates (biological half-lives) measured for predators in the laboratory were used to estimate probable food consumption rates in the tagged field areas. Results show that predaceous arthropods consume a much larger amount of the arthropod herbivore biomass than do predaceous vertebrates in an herbaceous ecosystem. For a small tagged forest stand, data are less conclusive but still suggest that predation by arthropods exceeds predation by vertebrates. (Abstr.)

545 James, H. G. INSECT PREDATORS OF UNIVOLTINE MOSQUITOES IN WOODLAND POOLS OF THE PRE-CAMBRIAN SHIELD IN ONTARIO. Can. Ent. 98, 5 (1966) 550-555.

Mosquito larvae tagged with ^{32}P were released in woodland pools to identify their predators. Large numbers of 2nd- and 3rd-instar larvae of Aedes communis (Deh.), A. stimulands (Walk.), and A. trichurus (Dyar) were collected from each of the pools and put into plastic-coated metal tanks containing 75 l of strained pond water. The isotope, as $H_3{}^{32}PO_4$, was added, to give 0.3 μCi/ml. Fourteen of 38 species of aquatic insects collected had ingested tagged Aedes. The leading predators were Dytiscidae and one species each of Gyrinus, Gerris, Callicorixa, and Asynarchus. Records are new for Asynarchus sp., Callicorixa audeni Hung., Dytiscus sp., Gerris buenoi Kirk., and Ilybius discedens Shp. The mosquito predator fauna at Cordova Mines and that of previously studied pools at Chatterton, Ontario, are compared.

546 Komeyev, G. A. THE NATURE OF (?) USE OF GREAT GERBIL COLONIES BY MIDDAY GERBILS DETERMINED BY RADIOACTIVE TAGGING. Nauch. Dokl. vŷssh. Shk., Biol. Nauk. No. 1 (1967) 26-30. (In Russian, with English summary)

No close epizootic contact was found, on studying Xenopsylla gerbilli.

547 Mook, L. J., Davies, D. M. THE EUROPEAN PRAYING MANTIS (Mantis religiosa L.) AS A PREDATOR OF THE RED-LEGGED GRASSHOPPER (Melanoplus femurrubrum (De Geer)). Can. Ent. 98, 9 (1966) 913-918.

Grasshoppers were made radioactive by feeding them leaves of dandelion (Taraxacum) and alfalfa (Medicago), sprayed with a ^{32}P-solution; ~50-100 μCi ^{32}P were used for 300-400 grasshoppers and about half of this was ingested during the feeding period. Normal food was withheld from 12-24 h before radioactive food was offered for a 24-h feeding period. Grasshoppers had been fed on non-radioactive food for 48 h prior to their being given ^{32}P-food. An assessment was made of the number of M. femurrubrum eaten by M. religiosa under seminatural conditions. The predator showed a functional response to changing prey densities with a continuously lowered increase in the number of prey removed from the population.

See also:

11 Location of univoltine Aedes eggs in woodland pool areas and experimental exposure to predators. (James, H. G., 1966)
13 A method of P^{32} labeling of the armored and soft scale predator Chilocorus bipustulatus L. (Peleg, B. A. et al., 1966)
432 Haemolymph circulation in the dragonfly wing and its suitability as substrate for the parasitic Arrenurus larvae (Acarina, Hydrachnellae). (Münchberg, P., 1963)
489 Investigation of hibernation of Perillus bioculatus Fabr. tagged with ^{60}Co. (Wegorek, W. et al., 1965)
516 Comparative movement of ^{106}Ru, ^{60}Co, and ^{137}Cs in arthropod food chains. (Crossley, D. A., Jr., 1967)
517 32-phosphorus tracer studies of a horseweed-aphid-ant food chain. (Cruy, A. A., de la et al., 1967)
529 Radioecology of the Colorado range; Terminal Report. (Osburn, W. S., Jr., 1964)
535 Possibility of contamination of insectivorous game birds during ecological investigations using insects labeled with ^{60}Co. (Wegorek, W. et al., 1963)
566 Ectoparasitic contacts between some mammalian species in great gerbil colonies. (Korneyev, G. A., 1967)
567 A quantitative estimate of the possibilities of a territorial advance of a plague epizooty in a population of great gerbils (Northern Kyzyl-kum). (Rudenchik, V. et al., 1967)

1.3.3.4. Insect - Plant (including Pollination, and Forest Infestation)

548 Crossley, D. A., Jr. RADIOISOTOPE MEASUREMENT OF FOOD CONSUMPTION BY A LEAF BEETLE SPECIES, Chrysomela knabi Brown. Ecology 47 (1966) 1-8 and ORNL-P-257, Oak Ridge National Lab., Tenn.

A radioisotope method was used previously for estimating vegetation consumption by a community of about 400 species of insects living on an area contaminated with radioactive waste effluents, the White Oak Lake bed at Oak Ridge, Tenn. Insects feeding on radioactive plants accumulated radiocaesium and reached a steady-state equilibrium concentration, in which intake of ^{137}Cs was balanced by its elimination of ^{137}Cs. Information on biological half-lives (elimination rates) for caesium provided the means for estimating ^{137}Cs intake. A study was undertaken to evaluate such a radioisotope technique by using a single insect species, for which the rate of food consumption could be measured both by radioactive tracer methods and by weighing the food in controlled experiments. Thus the uptake of ^{137}Cs was investigated for beetle larvae (C. knabi) feeding on willows in the White Oak Lake bed. Food intake rates were estimated from radiocaesium intake rates by measuring ^{137}Cs concentrations in willow leaves. Food intake rates estimated by this method for field areas were 7-16 mg dry weight of plant/

larva/d. Lab measurements of food consumption rates, by comparison, were about 9-10 mg/larva/d for larvae of similar size. Influences of temperature on biological half-lives were also studied, but no correction was applied to the field estimates since mean field temperatures were close to those used in lab experiments. The good agreement between lab and field measurements supports the validity of previous applications to entire communities of plant-feeding insects. The method would be equally useful with predaceous animals as with herbivores (NSA 20:1966, 35210)

549 Ehrhardt, P. ÜBER DIE BEZIEHUNG DER LATENZLARVEN VON Chaetophoria xanthomelas Koch (APHIDIDAE, HOMOPTERA) ZU IHRER WIRTSPFLANZE. (Studies on the relationship between the aestivating larvae of Chaetophoria xanthomelas Koch (Aphididae, Homoptera) and their host plant.) Z. angew. Zool. 54 (1967) 21-36. (In German, with English summary)

Contrary to the prevailing knowledge it was shown that the aestivating larvae of Ch. xanthomelas do not remain inactive in stiffness on the underside of the leaves of Acer platanoides. The gregarious larvae are quite mobile, leaving their position in the characteristically composed colony when disturbed, but returning to the same spot after a while. The aestivating larvae produce honeydew. The amount of honeydew excreted in 1 h in the average is equivalent to 10% of the larval body wt. This is consistent with the honeydew production of aphids sucking in sieve tubes. Resting in the colony or walking on the epidermis the aestivating larvae show the feeding behaviour which is typical for other aphids sucking in the phloem. Usually the stylets are intercellularly inserted in the plant tissue ending inside of a conducting bundle in the area of the phloem. In any case the nerves are punctured laterally; the stylets are never exclusively introduced into the leave tissues in vertical direction. The ejection of saliva is vigorous; inside of a conducting bundle there are frequently numerous cells completely filled with saliva. The larvae take up ^{32}P out of leaves marked with this tracer. In the beginning the radioactivity of the insects is increasing considerably, reaching a max. after 2 d, and showing no significant alteration after this time. The increase of radioactivity in the honeydew is only slight but continuous. The count-rate of the honeydew amounts to 41% of the larval radioactivity after a sucking time of 10 h and to about 25% after 48-64 h. This suggests that the aestivating larvae assimilate less phosphate than do other phloem sucking aphids developing without a diapause. The desiccation of the larvae by loss of water due to transpiration is prevented by a continuous uptake of sieve tube sap. In addition to this fact it is possible to hold up the reduced metabolism by resorption of nutrients. (Auth.)

550 Haragsim, O., Veselý, V., Šedivý, J., Taimr, L., Dočkal, J., Balcar, J. ACTIVITY OF HONEY-BEES MARKED WITH RADIOISOTOPES AND MOVED TO FIELDS OF LUCERNE (Medicago sativa). p. 1-3 of "Apimondia. 20th International Beekeeping Jubilee Congress. Bucharest, Roumania, 26-31 Aug., 1965". II/4. (In English)

Colonies of Apis mellifera caucasica were labelled with ^{32}P via mono-sodium phosphate of a specific activity of 480 µCi/ml per colony. Colonies of local hybrids (A. m. mellifica X A. m. carnica) were labelled with colloid gold (^{198}Au) (435 µCi/ml per colony). The differentiation of the differently labelled bees was effected by an absorption method, using a combination of two aluminium filters of 1058 and 405 mh/cm^2, respectively. The reliability of detection was checked on the basis of a biometrical comparison of proboscis lengths of each of the two races. Differences in flight distribution, the number of flowers visited, and the frequency of lucerne pollen masses were analysed for statistical significance. A statistically significant difference was only found between the size of the masses of lucerne pollen collected by the different species. Caucasian bees did, however, dispatch fewer foraging bees than the local hybrids. They tended to change their orientation during flight to other sources of food. There was a predominance of Melilotus sp. pollen. Contaminated flowers which had been visited by radioactive bees belonged mostly to those of compositae (Cirsium, Lappa sp.) and Convulvulus vulgaris. Radioactivity was concentrated on nectaries or in their vicinity. The significance of the glandular secretion involved during the feeding is discussed. Contaminated flowers were concentrated on the borders of the field. The advantage of moving colonies to lucerne fields for more perfect pollination has been confirmed.

551 Haragsim, O., Veselý, V., Šedivý, J., Taimr, L., Dočkal, J., Balcar, J. POROVNANI CINNOSTI NEKTERYCH GEOGRAFICKYCH RAS VCELY MEDONOSNE (Apis mellifera L.) NA VOJTESCE SETE. (Comparison of the activity of some geographical races of the honeybee (Apis mellifera L.) on luceme.) Sb. čsl. Akad. zeměd. Věd 11 (1965) 861-872. (In Czech, with Russian, English, and German summaries)

The activity of bee colonies of local origin (A. m. carnica X A. m. mellifera) and of bee colonies of the Caucasian race (A. m. caucasica) moved to pastures was compared with the activity of bees from

neighbouring apiaries. Bee colonies labelled with radioisotopes (^{32}P and ^{198}Au, respectively) when moved to a lucerne field, oriented themselves towards the flowers of lucerne. The flight of marked bees was most intensive in the immediate proximity of the locality of the hives, and decreased with distance. Flowers contamined by the bees were found up to a distance of 1 km. An effective range of flight for the practical requirements of pollination and migration of hives must be considered to be up to 500 m. The number of flowers visited by the bees of the migratory colonies and the percentage of flowers opened per minute compared with the activity of bees from neighbouring apiaries proved statistically insignificant. In all Caucasian bees caught on flowers of lucerne the pollen grains were found on the lower side of the head, and in local bees in 86.6% of cases, which is statistically different. Under the conditions of the experiment no superior pollinating activity of Caucasian bees was proved. On the basis of the observations the moving of local acclimatized colonies directly to the field proved to be a suitable measure particularly in cold, rainy years, when bees visit only plants in the immediate proximity of the hives.

552 Kloft, W., Gösswald, K. UNTERSUCHUNGEN ZUR FORSTLICHEN BEDEUTUNG DER HOLZ-ZERSTÖRENDEN ROSSAMEISEN UNTER VERWENDUNG DER TRACER-METHODE. (Studies by means of the tracer method of the significance of wood-destroying carpenter ants to forestry.) Anz. Schädlingsk. 37, 11 (1964) 163-169. (In German)

Carpenter ants of the genus Camponotus are well known as wood-destroying insects in the forests of northern and southern Europe. They have also been known to cause significant damage in Central Europe as has been illustrated in a forest in northern Bavaria, at 340 m above the sea level. Whereas individual infested stems may be found throughout the entire forest area, a high percentage of infested stems was found in sunny and warm marginal zones. The ants appear to prefer Norway spruce but also settle in pine and occasionally in oak, beech or birch. The actual damage proved to be caused by Camponotus herculeanus L. which is more arborical than C. ligniperda Latr. Knowing the pronounced tendency to regurgitate ^{131}I was fed in a diluted honey solution, to determine the precise nest area of Camponotus colonies. The nesting area of a single colony could be demonstrated to cover several stems and to be much more extensive than might be gauged from the damage visible externally.

553 Petty, R.O., Williams, E.C., Jr. RATES AND PATTERN OF RADIOISOTOPE RELEASE FROM FRESH TREE LITTER AT THREE LEVELS OF MESIC FOREST DEVELOPMENT. COO-1006-4, Wabash Coll., Crawfordsville, Ind. Dept. of Biology. 1965, 104p.

Findings are summarized from a 4 yr study of the rates and pattern of release of certain radioactive elements from fresh tree litter at three stages of mesophytic forest development. Young saplings of various tree species were inoculated with tracer amounts of ^{137}Cs, ^{32}P, ^{86}Rb, or ^{85}Sr and the activities in leaves, twigs, adjacent soil, and leaf litter were determined after various time intervals. The ecosystems studied included an old field, an oak forest, and a beech-maple climax forest. Records of precipitation and temperature were maintained and a number of related studies were carried out, including a study of secondary uptake of radionuclides by proximal vegetation, a survey of microbal populations in the leaf litter, and the uptake of ^{32}P by insects inhabiting the forests. Ecological implications of the findings are discussed. (NSA 20:1966, 12566)

554 Šedivý, J., Taimr, L., Veselý, V., Haragsim, O., Dočkal, J., Balcar, J. EVALUATION OF ACTIVITY OF HONEYBEE COLONIES MOVED TO A LUCERNE SEED FIELD. Acta. ent. bohemosl. 63. 1 (1966) 1-9. (In English)

Activity of bees moved to a lucerne seed field was studied. The bees were marked with ^{32}P and ^{198}Au. On the lucerne stand, 83.8 bees worked per 100 m^2, of which 39% were labelled bees. The percentage of marked bees decreases with increasing distance from their hives; at a distance of 200 m, there were 47%; at 500 m only 28% of labelled bees. Of the bees from neighbouring apiaries located in a radius of 2.5 km, 7.5% participated in the pollination work. Lucerne pollen masses lodged in the proboscis fossae were more frequently found in marked bees. The labelled and non-labelled bees did not differ in their activity, visiting 15 flowers/min on an average but tripping only 1.2% of the flowers visited. The percentual occurrence of labelled bees in the field was higher during early morning and late afternoon. The farthest distance from the hive covered by labelled bees was 1 km. Certain plant species were contaminated by the bees.

555 Taimr, L., Diribek, J. VYMEZENÍ OKRUHU HOSTITELSKÝCH ROSTLIN BZUNKY JEČNÉ (Oscinella frit L.) POMOCÍ P^{32} V POTRAVĚ HMYZU. (Definition of the range of host plants of the frit fly (Oscinella frit L.) by means of ^{32}P in the feeds of the insects.) Věd. Pr. výzk. Úst. rostl. Výroby Prace-Ruzyni 12 (1967) 29-36. (In Czech, with Russian, English, and German summaries)

By means of radio-phosphorus administered in the feed to imagines of the frit fly (Oscinella frit L.) the grass species most attractive for this pest were determined. They are: Arrhenatherum elatius (L.) Presl, Dactylis glomerata L., Festuca pratensis Huds., Lolium perenne L. and Phleum pratense L. Poa pratensis L. and Lolium multiflorum Lam. stand between the frequented and less frequented grass species. Less attractive species were found to be: Festuca ovina L., Trisetum flavescens (L.), P. Beauv., Festuca rubra L., Alopecurus pratensis L., and Agrostis stolonifera L. Attractiveness was estimated, on the one hand, according to the number of laid radioactive eggs, and, on the other hand, according to the length of the stay of the pest on the plant determined according to the quantity of radioactive droplets of excrements. The results obtained by means of this method conformed to the results obtained in field tests. (Auth.)

556 Wiegert, R. G., Odum, E. P., Schnell, J. H. FORB-ARTHROPOD FOOD CHAINS IN A ONE-YEAR EXPERIMENTAL FIELD. Ecology 48, 1 (1967) 75-83.

^{32}P-tracer studies of plant-arthropod food chains showed a significant difference in both consumer diversity and grazing pressure between the two dominant plant species on a 1st-yr weed field in South Carolina. Where Heterotheca subaxillaris was the labelled plant, ^{32}P was transferred readily to a number of phytophagous insects and secondarily to the predator fauna. Where only the plant Erigeron canadensis was tagged, there was little transfer of the isotope to the consumer populations, with the exceptions of the ant Dorymyrmex and the tree cricket Oecanthus. Dorymyrmex is a predator-scavenger, but also tends the aphids present on Erigeron; this latter habit accounted for the high uptake and unusual retention pattern of ^{32}P by this ant where Erigeron was tagged. Oecanthus was primarily an herbivore, but the data suggest some predation on aphids from Erigeron plants. Very little ^{32}P was transferred to the detritus eaters during the 43-d period of the study. Further support is given for the use of radioisotope to study trophic position of organisms as well as grazing pressure and food chain diversity associated with single species of terrestrial primary producers. The classification of the 28 frequent and dominant species or groups for which trophic transfer indices were calculated is given in the following checklist:

Insecta

Orthoptera:	Melanoplus femur-rubrum and M. biliteratus: grasshopper	
	Oecanthus celerinictus*: tree cricket	
	Gryllus firmus: field cricket	
Hemiptera:	Nysius raphanus: plant bug	
	Harmostes reflexulus: grass bug	
Homoptera:	Aceratagallia sanguinolenta	leafhoppers
	Empoasca sp.	leafhoppers
	Cuerna costalis	leafhoppers
	Carneocephala flaviceps	leafhoppers
	Scaphytopius acutus:	leafhoppers
	Clastoptera xanthocephala: spittlebug	
	Pissonotus delicatus	plant hoppers
	Delphacodes sp.	plant hoppers
Coleoptera:	Triplectrus rusticus: ground beetle	
	Selenophorus palliatus: ground beetle	
	S. ellipticus: ground beetle	
	Conoderus vespertinus: click beetle (or tobacco wireworm)	
	Olibrus sp.:	flower beetles
	Mordellistena sp.	flower beetles
	Altica marvegans: leaf beetle (flea beetle)	
	Apion sp.: snout beetle	

* About 8% of the tree crickets were later found to be O. quadripunctatus.

Lepidoptera: (grouped):		moths
Diptera: (grouped):		flies
Hymenoptera:	Dorymyrmex pyramicus:	pyramid ant.
other than ants: (grouped):		bees and wasps
		Arachnida
Araneida (grouped):		spiders

See also:

23 Insect labelling with rare earths for studying forest pests. (Weldinger, N. et al., 1966)
470 Study on the nutrition of Myzodes persicae Sulzer by means of ^{32}P. (Cavalloro, R., 1961)
471 Study of the tropic relation between aphids and their host plant by means of ^{14}C. (Cavalloro, R., 1963)
480 Localization of the functioning sieve cells in secondary phloem tissue of Metasequoia glyptostroboides. (Kollmann, R., 1965)

1.3.4. Population Dynamics

557 Raimundo, A. C., Roda Santos, M. L. COMBATE AOS INSECTOS. I. A MARCAÇÃO DA MOSCA DA FRUTA (Ceratitis capitata Wied.) COM FÓSFORO RADIOACTIVO P^{32} NO MÉTODO DOS MACHOS ESTERILIZADOS. (Insect control. I. Labelling the fruit fly (C. capitata) with radioactive phosphorus for the sterile-male method.) Garcia de Orta 13, 3 (1965) 351-358. (In Portuguese, with English and French summaries)

In preparation for studies on the possible eradication of C. capitata (Wied.) from Portugal by the use of the sterile-male technique, preliminary investigations were carried out on the labelling of adults with ^{32}P for population studies. Larvae were reared from the time of hatching on an artificial medium to which ^{32}P was added at rates of 0.1, 0.3, 0.5 or 1 μCi/g. The radioactivity of the resulting adults was determined 0, 1, 2, 3 and 4 weeks after emergence, and it is concluded that, when labelled flies are to be recaptured within less than a week of their release, the lowest rate, 0.1 μCi/g of larval medium, is adequate to ensure the recognition of radioactive adults, though higher doses are necessary for longer periods between release and recapture.(RAE-A 56:1968, ref. 659)

558 El-Miniawi, S. F., Hassanein, M. E. RADIOPHOSPHORUS IN LABELLING THE DESERT LOCUST FOR POPULATION ESTIMATION. Bull. Soc. ent. Egypte 48 (1964) 27-36.

Quantitative estimates were made of populations of 4th- and 5th-instar hoppers, adults, and of populations undergoing metamorphosis. Schistocerca gregaria Forsk were labelled with ^{32}P by ingestion. Activities ranged from 0.125-4 μCi/g wheat bran. Labelled wet or dry wheat bran baits were fed. Undesirable fermentation of the wet bait was controlled and mortality was reduced to a rate similar to that occurring when using green diet. The technique followed for estimating a population, density and composition, at a given interval is described, and its efficiency was tested by two statistical procedures. The method gave rise to a procedure for estimating the mortality rate in a given population. The number of percentage of hoppers emerging as adults within a given time were determined.

559 International Atomic Energy Agency, Vienna (Austria). DETERMINATION OF POPULATION DYNAMICS OF THE MEDITERRANEAN FRUIT FLY UNDER VARIOUS CONDITIONS IN TUNISIA BY MEANS OF RADIOISOTOPES; PART OF A CO-ORDINATED PROGRAMME OF INSECT CONTROL USING RADIATION. Research contract 168. p. 76-78 of "IAEA Research Contracts. Seventh Annual Report". Technical Reports Series No. 74. Vienna, International Atomic Energy Agency, 1967, 223p. STI/DOC/74.

Research Institution: Laboratory of Entomology, Tunisian National Institute of Agronomic Research, Ariana, Tunisia.
Principal scientific investigator: F. Soria.
Period of contract: 27 Dec. 1962 - 26 Dec. 1965.

1.4. ARTHROPODS AS DISEASE VECTORS

560 Broadbent, L. THE USE OF RADIOISOTOPES TO STUDY THE SPREAD OF PLANT PARASITES. p. 1-7 of "Isotopes and Radiation in Plant Pathology" Technical Reports Series No. 66. Vienna, International Atomic Energy Agency. 1966, 94p. STI/DOC/10/66.

Work with radioisotopes on pathogenic viruses, bacteria and fungi, and parasitic animals (e.g. nematodes, mites, and insect) is described. One section is devoted to studies on virus transmission by arthropods which include work on Myzus persicae, M. ascalonicus, Aphis fabae, Macrosteles fascifrons, and Orosius argentatus. Local or systemic toxicoses caused by insects are also considered as carried by M. persicae and Lygus oblineatus.

561 Dobyns, B.M. A STUDY OF THE PHYSIOLOGICAL FUNCTION AND HISTOLOGICAL CHANGES IN THYROIDS IRRADIATED WITH RADIOACTIVE IODINE. Annual Report, June 1, 1965-June 1, 1966. TID-23228, Western Reserve Univ., Cleveland, Ohio. Dept. of Biochemistry. 1 Jul. 1966, 8p.

Progress in clinical and experimental studies of the effects of radiation on the thyroid is reported. Experimental data were also collected on rats administered ^{131}I and were concerned with DNA synthesis in irradiated and antithyroid-drug stimulated rats and with nuclear changes at the time of neoplasm formation in rat thyroids. The role of fleas in transmitting Pasteurella pestis was studied.

562 Freitas, J.R., Campos, M. DADOS PRELIMINARES SOBRE O RITMO DE ELIMINACAO DO FERRO EM Triatoma infestans DETERMINADO PELO FERRO RADIOATIVO (Fe-59). (Preliminary data on the elimination rate of iron from Triatoma infestans, determined by means of radioactive iron, ^{59}Fe.) Cienc. Cult., Maracaibo 12, 3/4 (1960) 164-165. (In Portuguese)

T. infestans is a vector of Chagas' disease. Chickens were used as hosts. They were injected with ^{59}Fe in citrate solution. T. infestans was allowed to feed 2-3 d after injection. Samples of chicken blood were taken 1 h before and after feeding of T. infestans. A special scintillation counter was used to determine the quantity of blood ingested and the quantity of Fe involved. Iron elimination from T. infestans was determined. Triatoma did not eliminate Fe in the urine or in the plasma excreted a few hours after feeding. On the 6th day after feeding, adults (a) and 5th-instar nymphs (n-5) had eliminated nearly 4% of the ingested Fe whereas the remaining 50% of nymphs had not eliminated anything. By the 7th and 36th day, (a) had eliminated 43 and 71%, (n-5) 18 and 48%. Thirteen of 15 (n-1) had eliminated nothing. The quantity of faeces eliminated at the time of feeding is linked with the fasting history of the insect, the phase in its life cycle and the time for digestion. With less blood ingestion, Fe was eliminated more quickly. (a) ingested less than (n-5) and showed a more rapid digestion initially. At least 1 (a) retained ~2% Fe as it eliminated faeces without Fe.

563 Freitas, J.R., Mayrink, W., Mansur Neto, E. QUANTIDADE DE SANGUE INGERIDA IN NATURA POR Phlebotomus longipalpis (PSYCHODIDAE) DETERMINADA PELO FERRO RADIOATIVO (Fe^{59}). (Quantity of blood ingested in vivo by Phlebotomus longipalpis (Psychodidae) as determined by means of radioactive iron.) Cienc. Cult., Maracaibo 12, 3/4 (1960) 164. (In Portuguese)

In order to determine feeding rate, young cocks were injected with labelled iron citrate solution. The average blood volume was determined from the radioactivity acquired by feeding mosquitoes on the cocks. Phlebotomus longipalpis is the vector of leishmaniosis. The experiments were carried out with 100 mosquitoes originating from two captures. The average volume of blood ingested was 0.60±0.14 mg, with max. and min. values of 0.95 and 0.33 mg. They were tested in 38 batches of five mosquitoes each. The method is suitable for even smaller amounts ingested.

564 Jenkins, D.W. RADIOISOTOPES IN ENTOMOLOGICAL STUDIES OF ENDEMIC AND TROPICAL DISEASES. AD-636896, Army Biological Labs, Frederick, Md. 1960, 33p.

For abstract, see II/481.

565 Jenkins, D.W. RADIOISOTOPES IN ENTOMOLOGY AND TROPICAL MEDICINE. Science, N.Y. 133 (1961) 1836.

Two international symposia * were held recently on the present state of research and the current uses of radiation and radioisotopes in medicine and entomology. New uses are described, as the behaviour of labelled insecticides in plants and animals, insect control, use of lethal genes for control studies.

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* 1. see "Radioisotopes and Radiation in Entomology". Proceedings of a Symposium. Bombay, 5-9 Dec. 1960. STI/PUB/38. Proceedings Series. Vienna, Austria, International Atomic Energy Agency. 1962, 307p.

2. see "Radioisotopes in Tropical Medicine". Proceedings of a Symposium. Bangkok, 12-16 Dec. 1960. STI/PUB/31. Proceedings Series. Vienna, Austria, International Atomic Energy Agency. 1962, 379p.

566 Korneyev, G. A. ECTOPARASITIC CONTACTS BETWEEN SOME MAMMALIAN SPECIES IN GREAT GERBIL COLONIES. Parazitologiya 1, 3 (1967) 233-237.

Fleas (Xenopsylla gerbilli) were shown to be transmitted by gerbils and weasels by using radioisotopes for labelling.

567 Rudenchik, Y. V. et al. A QUANTITATIVE ESTIMATE OF THE POSSIBILITIES OF A TERRITORIAL ADVANCE OF A PLAGUE EPIZOOTY IN A POPULATION OF GREAT GERBILS (NORTHERN KYZYL-KUM). Zool. Zh. 46, 1 (1967) 117-123. (In Russian, with English translation?)

Epizootic spread was found to be favoured in the spring and autumn when Xenopsylla gerbilli are most active. The fleas were tagged with radioisotopes.

568 Sonenshine, D. E. USE OF RADIOISOTOPES FOR STUDIES ON THE ECOLOGY OF TICK VECTORS OF DISEASE. Progress Report, April 1, 1966-January 1, 1967. ORO-3514-1, Old Dominion Coll., Norfolk, Va. 12 Dec. 1966, 60p.

Techniques for labelling immature ticks were developed, and a comparison of the relative usefulness of different radioisotopes made (^{32}P, ^{3}H-glycine, ^{90}Sr, ^{137}Cs, ^{144}Ce in solution). Except for ^{144}Ce- and ^{32}P-treated ticks, most of the inoculated ticks laid eggs. The incorporation of radioisotopes into eggs and larvae is in some way related to (1) the period of oviposition, and (2) the activity originally inoculated into the parent. There is a lethal activity level above which hatching does not occur. Apart from inoculation, immersion and dusting techniques were tested. Samples of 100 larval ticks in 0.2 cc aqueous solution containing 2 μCi/cc ^{144}Ce, or a similar solution in which 10% dimethyl sulphoxide had been incorporated was used. Immersion was repeated using a 1 cc solution (2 μCi/cc) and a vacuum pump for rapid drying. For dusting, larvae were allowed to crawl across previously treated Sudan III powder. The efficiency of the inoculation technique, efficiency of transovarial transmission of radioisotopes, the calculation of dosage, and the biological effects of radiolabelling were studied, also the applicability of methods to other tick species. Engorged female ticks (Dermacentor variabilis, Dermacentor andersoni, and Amblyomma americanum) were inoculated with ^{14}C-glucose or ^{14}C-glycine during varying oviposit periods. Progeny of those inoculated during the late oviposit period were unsuitable because of the low radioactivity levels. A more uniform yield was obtained in the 1-5 d oviposit periods. Large populations of labelled progeny were produced. The results of field trials with radioactive larvae demonstrated the feasibility of recapture of radioactive individuals on hosts. It was concluded that mass labelling by inoculation of suitable radioactive materials can be used in field studies on the ecology of ticks. (NSA 21:1967, 6469)

569 Tatchell, R. J. SALIVARY SECRETION IN THE CATTLE TICK AS A MEANS OF WATER ELIMINATION. Nature, Lond. 213 (1967) 940-941.

During engorgement large amounts of water which have passed across the gut epithelium into the haemolymph are returned to the host in the salivary secretion of the tick. Experiments were carried out on eight ticks (Boophilus microplus (Canestrini)), each 5-6 mm in length and already attached to a calf. They were each injected with 4.4 μl (5 Ci/ml) of ^{3}H-water. From this and other experiments it would appear that in B. microplus and probably other Ixodidae the blood meal is concentrated, and electrolytic and osmotic imbalance avoided by a remarkable adaptation of the salivary secretion.

See also:

22 The use of labeled mosquitoes for studying population problems. (Vargas L., 1964)
475 Relationship of tracer-measured aphid feeding to acquisiton of beet western yellows virus and to feeding inhibitors in plant extracts. (Duffus, J. E. et al., 1967)
739 The application of radioisotopes to study the mode of action of pesticides used against plant viruses and their insect vectors. Research contract 236. (International Atomic Energy Agency, Vienna, Austria, 1967)

1.5. CHEMICAL CONTROL MEASURES

1.5.1. General Articles, Surveys

570 Costa, J.J. PENETRATION AND TRANSLOCATION OF A LABELED SYSTEMIC INSECTICIDE. p. 128-130 of "Actas de la Reunión Latino-americana de Fitotecnia. Paper presented at the 6th Latinamerican Meeting on Crop Farming. 1964". Published 1965. (In Spanish)

571 Dedek, W. RADIOAKTIVE NUKLIDE IN DER CHEMIE DER PESTIZIDE. III. (Radioactive nuclides and pesticide chemistry. III.) Atompraxis 13 (1967) 202-208. (In German)

A bibliography of 505 references, divided into sections on ^{14}C-labelled insecticides (including general reviews, phosphoric acid esters, halogenated hydrocarbons, carbamates and pyrethrins), herbicides (reviews, phenoxyacids, derivatives of benzoic acid and of aliphatic acids, carbamates, "-uron" compounds, triazine, derivatives of pyridine, miscellaneous, auxines and purines), ^{3}H-labelled insecticides, and variously labelled metals and metal compounds.

572 Disney, R. W. RADIOMETRIC DETECTION OF EXPOSURE TO INSECTICIDES. Am. J. med. Electron. 4, 2 (1965) 70-72.

The principles of the new radiometric method for the assay of cholinesterase activity in small samples of human blood are explained and the apparatus used for field assays illustrated. The advantage of this method is the use of a low substrate concentration and minimal sample dilution, which makes the method significantly more sensitive to inhibition by carbamate insecticides than conventional methods. The employment of simple microtechniques and a portable, thin end window Geiger-Müller counter enables the method to be used under field conditions. (Auth.)

573 Finlayson, D. G., McCarthy, H. R. THE MOVEMENT AND PERSISTENCE OF INSECTICIDES IN PLANT TISSUE. Res. Rev. 9 (1965) 114-152.

Comprehensive review article. It is divided into two main parts. One deals with insecticide movement in plants (foliar, fruit, root, seed, and stem absorption; translocation of systemic, residual and contaminant insecticides; metabolism; and the effects on plants). The other part deals with insecticide persistence in plant tissue (efficacy; residues). Throughout, much of the supporting data cited is drawn from studies in which radioisotopes had been used (cf. three preceding volumes of the bibliography).

574 French, A. L., Hoopingarner, R. ABSORPTION AND METABOLISM OF INSECTICIDES IN Escherichia coli. Bull. ent. Soc. Am. 12 (1966) 266. Abstr. 65. "Portland Meeting, Portland, Oreg., USA, 28 Nov.-1 Dec. 1966".

Aerobic and anerobic uptake and metabolism of ^{14}C-labelled insecticides were studied using E. coli, strain B. The insecticides and metabolites were monitored using gas chromatography and liquid scintillation counting. The adsorption and metabolism varied significantly depending upon the metabolic state of the bacteria. (Abstr.)

575 Hartisch, J. UNTERSUCHUNGEN ÜBER DAS VERHALTEN VON PFLANZENSCHUTZMITTELN IN DER PFLANZE UND IM PARASITEN UNTER VERWENDUNG MARKIERTER ATOME. (Study on the fate of plant protectants in the plant and parasites by using labelled atoms.) NachrBl. dt. PflSchutzdienst, Stuttg. 14 (1960) 26-32. (In German)

The present state of the art in the application of radioisotopes to research on plant protection is reviewed. The various methods used for testing the action and fate of fungicides, insecticides, and herbicides are described.

576 Helbig, W., Beer, M., Kuhn, E. DISTRIBUTION MEASUREMENTS FOR TESTING NEW DEVICES OF INSECTICIDE AND FUNGICIDE SPREADING. Isotopenpraxis 3 (1967) 334-338. (In German)

For testing the homogeneity of distributions of sprayed and atomized pesticides spread from air-borne or car-borne devices, new techniques of labelling with ^{198}Au were developed. Leaves of the plants or blank films exposed on the area to be investigated were measured using an automatic counting device. The method is part of testing new devices for pesticide spreading. (Auth.)

577 International Atomic Energy Agency, Vienna (Austria). RADIOISOTOPES IN THE DETECTION OF PESTICIDE RESIDUES. "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, 12-16 Apr. 1965". STI/PUB/123. Vienna, 1966. 118p.

The following topics were discussed at the panel meeting: historical background; use of radioisotopes in the detection of residues in meat and milk; the retention of triphenyltin and dieldrin, and its relevance to the toxic effects of multiple dosing; determination of rogor and cidial by the isotope dilution method; metabolism of triazine and 2,4-D herbicides, and problems with their residues in soils and plants; metabolism of chlorinated insecticides; isolation and identification of metabolites of some chlorinated insecticides and their detection by analytical methods; chemical and physical nature of plant cuticles in relation to the deposition and penetration of pesticides; development of double isotope derivative assays for measurement of pesticide residues; potential of neutron activation analysis of pesticides and metabolites; method of activation analysis for mercury in the biosphere and in foods; labeled reagents and substrates in pesticide analysis; advantages and disadvantages of conventional pesticide determination methods; problems in FAO on human and animal intoxication; problems in WHO on pesticide residues; the joint FAO/WHO programme on the toxicity of pesticide residues in food; the development and application of pesticide analysis methods.

578 Linskens, H.F., Heinen, W., Stoffers, A.L. CUTICULA OF LEAVES AND THE RESIDUE PROBLEM. Res. Rev. 8 (1965) 136-178.

This review is deliberately confined to the purely botanical problems of the physiology and pathology of the cuticular layers, including a discussion of the cuticula as a place to encounter residues. Some work in which radioisotopes were used is cited, e.g. in studies on the penetration of labelled pesticides through cuticular membranes.

579 Lisk, D.J. DETECTION AND MEASUREMENT OF PESTICIDE RESIDUES. Science, N.Y. 154 (1966) 93-98.

General article on residue sampling, extraction and isolation, spectrophotometric methods, gas chromatographic procedures, and other methods. The use of neutron activation analysis in residue analysis is mentioned (see ref. 633). Cl, Br, I, and Hg have been determined as elemental residue fractions in various samples. The method is sensitive in the part-per-billion range and often quite rapid, but will not distinguish between an element in inorganic or organic combination, and the equipment is expensive. The frequent use of ^{3}H, ^{14}C, ^{36}Cl, and ^{32}P in laboratory residue studies is pointed out.

580 Metcalf, R.L. ABSORPTION AND TRANSLOCATION OF SYSTEMIC INSECTICIDES. Agrochimica 11, 2 (1967) 105-123. (With German, French, Spanish, and Italian summaries)

The present status of systemic insecticides in agricultural pest control is reviewed. Systemic activity is determined by ability of the insecticide to penetrate roots, leaves, stem, or fruits; by optimum water solubility to permit translocation; and by sufficient stability in the plant environment. The influence of chemical structure on these factors has been evaluated using radiotracer molecules. Metabolism studies of systemic insecticides have shown the importance of the delay factor which permits the insecticides to be translocated in a relatively stable form and subsequently converted by in situ oxidation to a highly reactive and toxic molecule. This information can be utilised in the design of new systemic molecules. (Auth.)

581 Mussokin, A. P., Wladimirowa, T. M., Inkowa, J. N., Ossipow, W. A. PROBLEMS IN SYNTHESISING LABELLED COMPOUNDS. Radiochimiya No. 6 (1959) 734-737. (In Russian)

Glass apparatus with interchangeable components is described which permits the elimination and transfer of radioactive substance from one vessel to another. An improved method for synthesising $K^{14}CN$ from ^{14}C-citric acid is given.

OMISSION. Reference should here be made to 899, erroneously listed in the wrong context.

899 O'Brien, R. D. TARGET ENZYMES AND INSECTICIDAL ACTION. p. 35-39 of "Research in Pesticides". Proceedings of the "Conference on Research Needs and Approaches to the Use of Agricultural Chemicals from a Public Health Viewpoint. Davis, Calif., USA, 1-3 Oct. 1964." Chichester, C. O., Ed. New York, Academic Press. 1965. 380p.

582 O'Brien, R. D. MODE OF ACTION OF INSECTICIDES. A. Rev. Ent. 11 (1966) 369-402.

Selected areas of the field are reviewed in critical detail. The following are discussed specifically: botanicals (rotenone, nicotine); organophosphates (Ruelene®, Imidan®, Bayer 22408, Colep®, dimethoate, dichlorvos, Bidrin. Reaction with cholinesterase is discussed in some detail, also synergism and demyelination, and some objections to the "mutant aliesterase" theory in connection with resistance). Death is still considered to be caused by cholinesterase inhibition from organophosphate inhibition); and DDT (complexity of mode of action, importance of degradation by reductive dechlorination, breakdown in various systems). Other aspects considered are selective toxicity and penetration of insecticides.

583 O'Brien, R. D. "Insecticides; Action and Metabolism". New York, Academic Press. 1967. 332p.

Textbook dealing with physical toxicants, organophosphates (chemistry and inhibitory activity, action, therapy, and metabolism), carbamates, DDT and related compounds, cyclodienes, nicotinoids, rotenoids, pyrethroids, fluorine compounds, lindane and other hexachlorocyclohexanes, synergism, antagonism, and other reactions, resistance, selectivity, penetration, and environmental health problems. A number of studies in which radioisotopes had been used are mentioned in the text.

584 Parke, D. V. RADIOISOTOPES IN THE STUDY OF THE METABOLISM OF FOREIGN COMPOUNDS. Isotopes exp. Pharmac. (1965) 315-342.

A review on the metabolism of compounds labelled with ^{3}H, ^{14}C, ^{35}S, and ^{36}Cl, including industrial chemicals and solvents, food additives, drugs, and pesticides. (CA 68:1968, 20623 n)

585 Perry, A. S. BIOCHEMISTRY OF INSECTICIDE RESISTANCE IN MOSQUITOES. Mosquito News 26, 3 (1966) 301-309.

The development of insecticide resistance has been particularly noticeable in mosquitoes. The author considers resistance to DDT-type compounds, organophosphorus and carbamate insecticides, available data being discussed. In numerous studies radioisotopes had been used. (Some unpublished work by the author is cited. Thus, only ^{14}C-dieldrin was found as a product of ^{14}C-aldrin metabolism by dieldrin-resistant Aedes aegypti and Anopheles quadrimaculatus.)

586 Peterle, T. J. THE USE OF ISOTOPES TO STUDY PESTICIDE TRANSLOCATION IN NATURAL ENVIRONMENTS. p. 181-191 of "Pesticides in the Environment and their Effects on Wildlife". Proceedings of an Advanced Study Institute sponsored by the North Atlantic Treaty Organization, Monks Wood, Experimental Station, England. 1-14 July 1965. Moore, N. W., Ed. J. appl. Ecol. 3, Suppl. (1966) 311p.

Tracer techniques are useful in studying the translocation and bioaccumulation of pesticides in natural environments. Sophistication of radioassay systems requires a relatively high initial cost for equipment but savings in personnel costs should more than offset these investments over a period of time. Satisfactory, labelled pesticidal compounds are available commercially at reasonable cost. Neutron activation analysis, autoradiography, and isotope dilution methods are also potential techniques for studying pesticide residues. Parallel development of techniques for studying radioactive fallout products in natural systems is discussed. Experimental data from two field experiments involving ^{35}S-malathion and ^{36}Cl-DDT are presented as examples of the isotope tracer technique. Preliminary estimates of standard deviations

and coefficients of variation suggest a relative constancy of variability for biological specimens. (Auth. summary)

587 Schütte, H. R. "Organisch-präparative Methoden. Band 3. Radioaktive Isotope in der organischen Chemie und Biochemie". Kirsten, W., Ed. Berlin, Deutscher Verlag der Wissenschaften. 1966, 689p.

The author of this book on radioactive isotopes in organic chemistry and biochemistry gives full details and general principles of syntheses with radioisotopes. The literature includes the beginning of 1965. A very valuable appendix consists of tabulated data on the synthesis of labelled organic compounds, table 2 (p. 270-546) listing ^{14}C-compounds, giving the formula, structural formula, and starting product for each compound. A total of 1921 references, many of which fall within the scope of this bibliography are given. A similar, but of necessity much shorter table on the synthesis of ^{32}P-labelled organic compounds (p. 594-608) gives 147 references (p. 609-612), some of which are relevant. Tables on ^{35}S, ^{131}I- and ^{85}Br-labelled compounds proved not relevant. The final table on ^{36}Cl-labelled compounds (p. 674-679), with its bibliography of 35 references (p. 680) contains a few pertinent references.

588 Winteringham, F. P. W. ACTION AND INACTION OF INSECTICIDES. The Fernhurst Lecture. Jl R. Soc. Arts 110 (1962) 719-740.

Review. The review discusses the need for more selective insecticides, the problem of insecticide resistance, the incidence of resistant insects in the field, behaviouristic and physiological resistance, detoxication as a mechanism of insect resistance, mechanisms of resistance not involving enzymic detoxication, cross-resistance, and the action of insecticides. The author finally considers current trends and prospects, better use of existing insecticides, and novel methods of chemical insect control. - Radioisotopes had been used in numerous of the studies cited.

589 Winteringham, F. P. W., Disney, R. W. A RADIOMETRIC METHOD FOR ESTIMATING BLOOD CHOLINESTERASE IN THE FIELD. Bull. Wld Hlth Org. 30 (1964) 119-125.

The increasing use of anticholinesterase insecticides such as organophosphates and carbamates against agricultural pests and disease vectors has emphasized the need for effective methods of detecting exposure in man. Estimation of blood cholinesterase activity provides an index of exposure to organophosphorus compounds. Therefore, a new, radiometric method was developed which provides for the simple and rapid measurement of human blood cholinesterase under field conditions. It involves minimal dilution of samples and use of very low substrate concentrations, and is thus more sensitive to cholinesterase inhibition by reversible anticholinesterases such as carbamates than the conventional manometric or change-in-pH methods. A 20-µl sample of haemolyzed whole blood is mixed with ^{14}C-labelled acetylcholine on a cavity microscope slide. After 0.5 - 3 min the mixture is acidified and dried. Under these conditions radioactive acetate liberated enzymatically is completely volatile while the radioactive unhydrolyzed substrate is not. The loss of radioactivity on acidification and drying is therefore a direct measure of the acetylcholinesterase activity. The levels of radioactivity employed are far below those likely to present any significant health hazard or to require special lab conditions. Although the method requires a labelled substrate, a single preparation is sufficient for several hundred thousand enzyme assays. (NSA 18:64, 29572)

590 Winteringham, F. P. W. COMPARATIVE METABOLISM AND TOXICOLOGY OF ORGANIC INSECTICIDES. Studies comp. Biochem. (1965) 107-151.

A review comparing the metabolic pathways of insecticides including the DDT group, the nitrophenol group, the hexachlorocyclohexane isomers and the halogenated benzenes, those derived from the cyclodienes and their related compounds, those of botanical origin including pyrethroids, nicotine, rotenone, the organic P compounds, carbamates, and their synthetic analogues. The toxicological significance of metabolism in vivo involving the synergism and antagonism of insecticides by non-specific inhibitors and structural analogues is also discussed. Mechanisms of enzymic detoxication and their inhibition is also mentioned. (CA 65:1966, 4576f)

591 Winteringham, F. P. W. COMPARATIVE METABOLISM AND THE TOXICOLOGY OF ORGANIC INSECTICIDES. p. - ? of "Studies in Comparative Biochemistry. Proceedings of a Symposium of the Biochemical Society. Munday, M. A., Ed." Int. Ser. Monographs pure appl. Zool. Div. 23 (1967) 208p.

See also:

67 Response of insects to radiation. (Hungate, F.P., 1966)
838 Sterilisation chimique des insectes nuisibles. (Rukavishnikov, B., 1967)
1730 Potential of neutron activation analysis of pesticides and metabolites. (Bogner, R.L., 1966)
1732 Les applications de l'analyse par activation aux produits agricoles et alimentaires. (Fourcy, A., 1965)
1733 Biology and neutron radiation: agronomical applications of radioactivation analysis. (Fourcy, A., 1967)
1750 A method for collecting $^{14}CO_2$ from a hydrogen flame detector. (Robbins, J.D. et al., 1967)
1753 Determination of the suitability of a microdoser for topical application of insecticides to the Colorado potato beetle. (Taimr, L. et al., 1967)
1757 Radioactive nuclides in pesticide chemistry. II. (Dedek, W., 1967)
1791 "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology, Gainesville, Fla., 4 Oct.-26 Nov. 1965". (IAEA, 1965)

1.5.2. Fumigants

502 Abrol, Y.P., Conn, E.E. CYANIDE METABOLISM IN Lotus arabicus AND Lotus tenuis. Phytochemistry 5, 2 (1966) 237-242.

L-valine-U-^{14}C and L-isoleucine-U-^{14}C served, respectively, as effective precursors of the aglycon moieties of the 2 cyanogenic glycosides, linamarin (α-hydroxyisobutyronitrile β-D-glucoside) and lotaustralin (α-hydroxy-α-methylbutyronitrile β-D-glucoside), which occur in L. arabicus and L. tenuis. ^{14}C-labelled asparagine isolated from the tops of etiolated seedlings of these species which had been fed ^{14}C-labelled HCN was degraded, and the distribution of radioactivity was measured; the amide C atom of asparagine was derived from the nitrile C. In plants fed L-valine-U-^{14}C, the occurrence and distribution of radioactivity in ^{14}C-labelled asparagine suggested that radioactive linamarin formed from valine breaks down slowly to ^{14}C-labelled HCN which in turn is incorporated into asparagine. (CA 64:1966, 16293a)

503 Binning, A., Darby, F.J., Heenan, M.P., Smith, J.N. THE CONJUGATION OF PHENOLS WITH PHOSPHATE IN GRASS GRUBS AND FLIES. Biochem. J. 103, 1 (1967) 42-48.

House flies (Musca domestica), insecticide-susceptible blowflies (Lucilia sericata) and New Zealand grass grubs (Costelytra zealandica) were tested. They were dosed with 1-naphthol, 2-naphthol or p-nitrophenol. The corresponding monoaryl phosphates were identified in extracts of insects or excreta along with the β-glucosides and ethereal sulphates of the phenols. No diaryl phosphates or glucosiduronates were detected but an unidentified metabolite of [^{14}C] 1-naphthol was present in extracts of flies dosed with [^{14}C] 1-naphthol.

504 Boose, R.B., Terriere, L.C. QUANTITATIVE ASPECTS OF THE DETOXICATION OF NAPHTHALENE BY RESISTANT AND SUSCEPTIBLE HOUSE FLIES. J. econ. Ent. 60, 2 (1967) 580-586.

The rate of metabolism and excretion of naphthalene-1-^{14}C and 1-naphthol-1-^{14}C by resistant and susceptible strains of house flies, Musca domestica L., has been studied by means of injection and feeding experiments. Combustion of insects given single doses of the radioactive drugs has shown that both are rapidly eliminated; approximately 80% of an injected dose is excreted within 7 h and 90% in 24 h. When fed up to 0.4% 1-naphthol in sugar, the flies excrete naphthol metabolites at the rate of approximately 3 to 5 μg/d/insect. Males of both strains excrete the metabolized drug about 50% more rapidly than females. About 23 to 68% of the excreted drug is in the form of 1-naphthyl glucoside and about 8 to 17% as 1-naphthyl sulfate. Relatively more glucoside is produced by young females but the absolute amount produced by the sexes is approximately the same. Although R- and S-insects were compared both quantitatively and qualitatively for naphthol metabolism, no differences either in rate of metabolite production or in relative levels of metabolites could be seen. (Auth.)

505 Bos, B.G., van den, Aten, A.H.W., Jr. THE SYNTHESIS AND PYROLYSIS OF RADIO-ACTIVE ETHYL FORMATE ($H^{14}COOC_2H_5$). Recl Trav. chim. Pays-Bas Belg. 70 (1951) 495-498. (In English)

First, $BaCO_3$ was converted into sodium cyanide.

$$Ba^{14}CO_3 + 5\,NaN_3 \rightarrow BaO + 7\,N_2 + 2Na_2O + Na^{14}CN$$

A mixture of 100 mg of radioactive $BaCO_3$, 1 g of sodium azide and 2 g of NaCl was heated to red heat in a pyrex test tube into which a slow current of N_2 was being blown. Heating was continued for 10 min after the decomposition of the azide was finished. Then the contents of the tube were allowed to cool and water was added. The mixture was transferred to a distilling flask, which already contained 100 mg of inactive NaCN. H_2SO_4 was added and the hydrocyanic acid was distilled into ice-water. For the saponification of hydrocyanic acid a solution of NaCN in a very small volume of water is needed. Therefore the hydrocyanic acid was precipitated with silver nitrate and after filtration the silver cyanide was put into a Carius tube and mixed with 0.5 ml of water. To this suspension the equivalent quantity of a concentrated solution of NaS was added, giving solid silver sulphide and a solution of $Na^{14}CN$. The tube and its contents were first cooled in ice and salt and then an excess of concentrated hydrochloric acid was added. The tube was sealed and kept for 8 h in a water bath at 75°C to effect the saponification:

$$H^{14}CN + H^+ + 2H_2O \rightarrow H^{14}COOH + NH_4^+$$

The contents of the tube were filtered and neutralized with NaOH. The subsequent preparation of ethyl formate from the solution containing formate and chloride is described. The method of pyrolysis (heating the quartz tube containing the pumice on which the ethyl formate was decomposed to 500° C in an electric furnace) is described in detail.

596 Darby, F.J., Heenan, M.P., Smith, J.N. THE ABSENCE OF GLUCURONIDE CONJUGATES FROM 1-NAPHTHOL DOSED FLIES AND GRASS GRUBS; DETECTION OF 1-NAPHTHYLPHOSPHATE. Life Sci. 5, 16 (1966) 1499-1502.

Phenols are detoxified in most insects by formation of phenyl-β-glucosides or phenyl sulphates but the biosynthesis of glucosiduronates in flies has also been reported. The metabolism of 1-naphthol in flies (Musca domestica and Lucilia sericata) and the New Zealand grass grub (Costelytra Zealandica larvae) was reinvestigated. Radioautographs of paper chromatograms prepared from extracts of flies or grubs dosed with [^{14}C] 1-naphthol (1 mCi/mM) showed spots coinciding with the positions of 1-naphthol, 1-naphthylglucoside, 1-naphthylsulphate, and 1-naphthylphosphate but no 1-naphthyl-glucosiduronate could be detected. Dilution analyses were carried out on extracts of grass grubs which had received [^{14}C] 1-naphthol in which added 1-naphthol was reisolated and crystallised. No glucosiduronate was detected although both the glucoside and sulphate of naphthol were found. All three species produced substantial amounts of 1-naphthyl dihydrogenphosphate.

597 Levi, G., Amaducci, L. CEREBRAL AMINO ACID TRANSPORT IN VITRO: EFFECT OF HYPOXIA INDUCED BY CYANIDE IN VIVO. Life Sci. 6, 18. Pt. II. (1967) 1935-1944.

Amino acid transport was studied in brain slices from rats acutely intoxicated with cyanide. In short time experiments (3 min) the slices were preincubated for 20 min in a regular medium containing no amino acid, then ^{14}C-amino acid containing medium was added, to give a final amino acid concentration of 2mM. In exit experiments the slices were preincubated for 30 min in a ^{14}C-amino acid containing medium. Amino acid concentrations were calculated by knowing the specific activity of the medium and the radioactivity of the tissue. The amino acids used were D-glutamate, α-aminoisobutyrate, and L-lysine. No difference from controls was found when slices were incubated in a glucose-containing medium. The inhibition of amino acid accumulation and the stimulation of amino acid exit observed in control slices when a glucose-free medium was used, were significantly diminished in slices from treated animals. The significance of the finding is discussed briefly.

598 MacDiarmid, A.G., Hall, N.F. THE PREPARATION OF $NaC^{14}N$ AND $NaCN^{15}$. J. Am. chem. Soc. 75 (1953) 4850-4851.

Many methods of preparing $Na^{14}CN$ from $Ba^{14}CO_3$ have been described. The present modification of Adamson's method has as its special feature that only ordinary laboratory apparatus is used, and no special pumping or heating arrangements are necessary. Although the yields are not quite as high as those obtained in some of the methods involving more complicated apparatus (see Can. J. Res. 28B: 1950, 345), the simple procedure described is excellent for rapid preparation. - $NaC^{15}N$ was prepared from potassium phthalimide containing ^{15}N. Four preparations were carried out using ordinary potassium phthalimide; yields of 97-100% were obtained in each case.

599 Outram, L. FACTORS AFFECTING THE RESISTANCE OF INSECT EGGS TO SULPHURYL FLUORIDE I. THE UPTAKE OF SULPHURYL-^{35}S FLUORIDE BY INSECT EGGS. J. stored Prod. Res. 3, 3 (1967) 255-260.

Investigation of the uptake of sulphuryl fluoride (labelled with ^{35}S) by eggs of Schistocerca gregaria (Forsk.) and Tenebrio molitor L. showed that penetration is mainly through the micropylar complex in the locust eggs and also through the general surface of the chorion in the eggs of T. molitor. Fumigant taken up by the eggs can be divided into recoverable and irrecoverable fractions. The uptake curve for the eggs of S. gregaria shows an initial delay in uptake but is otherwise similar to that found for T. molitor, in which uptake is rapid. Susceptible eggs take up and retain more fumigant per unit time than resistant eggs. The amount of fumigant taken up varies with the stage of embryonic development, and susceptible stages contain more irrecoverable fumigant than resistant stages. (From auth.)

600 Outram, L. FACTORS AFFECTING THE RESISTANCE OF INSECT EGGS TO SULPHURYL FLUORIDE. II. THE DISTRIBUTION OF SULPHURYL-^{35}S FLUORIDE IN INSECT EGGS AFTER FUMIGATION. J. stored Prod. Res. 3, 4 (1967) 353-358.

Investigation of the distribution of sulphuryl fluoride labelled with ^{35}S in fumigated eggs of Schistocerca gregaria (Forsk.) and Tenebrio molitor L. showed that labelled sulphur was found predominantly in the chorion and the hydrolysed protein fraction of the eggs of S. gregaria. In the more susceptible eggs of T. molitor, between 20 and 40% of the labelled sulphur was found in the protein hydrolysate, and up to 75% in the trichloroacetic acid extract. Only a very small amount of the sulphur was found in the ether extracts and the residual materials. It is suggested that resistance to this fumigant is due mainly to the impermeability of the egg shell, most of the fumigant being chemically held by the proteinaceous shell and epembryonic membranes. (From RAE-A 56:1968, ref. 1078)

601 Outram, L., Call, F. APPARATUS FOR THE SYNTHESIS AND APPLICATION OF RADIOACTIVE SULPHURYL FLUORIDE TO INSECT EGGS. J. stored Prod. Res. 3, 1 (1967) 71-74.

The sulphuryl-^{35}S fluoride was synthesised from sulphuryl-^{35}S chloride by repeated passage over potassium fluoride heated to 400°C in a closed evacuated system, the exchange reaction being $SO_2Cl_2 + 2\,KF \rightarrow SO_2F_2 + 2\,KCl$. The product was transferred to a storage reservoir on the vacuum manifold, whence it could be transferred to a dosing apparatus for application to eggs. The apparatus used for exposing the insects to the labelled fumigant is described and illustrated. It consisted of a gas pipette (8.70 ml volume) above an insect chamber (22 ml). A known amount of fumigant was introduced into the fumigation chamber. Full details of the procedure are given. Hatching tests showed that eggs were not damaged by short exposures at low pressure.

602 Schuching, S. von, Enns, T. LOW PRESSURE REDUCTION OF CARBON^{14}-LABELED BARIUM CARBONATE TO CYANIDE. J. Am. chem. Soc. 78 (1956) 4255.

The conditions of reducing ^{14}C-labelled $BaCO_3$ to ^{14}C-labelled cyanide with zinc were investigated. A low pressure steel reaction vessel which allowed control of all variables was constructed and gave reproducible high yields of cyanide. (Auth.)

603 Seawright, A. A., McLean, A. E. M. THE EFFECT OF DIET ON CARBON TETRACHLORIDE METABOLISM. J. Biochem. 105, 3 (1967) 1055-1060.

Blood and liver concentrations of CCl_4 were measured, at intervals after an oral dose, in rats given stock and protein-free diets. The values did not correlate with the resistance to poisoning found in the rats on protein-free diets. The metabolism of CCl_4 to CO_2 in vivo and in liver microsomal preparations was depressed in animals given protein-free diets. Rats given a single dose of DDT were highly sensitive to CCl_4 poisoning. The livers of such animals had an increased microsomal protein content and greatly increased microsomal activity in the demethylation of Pyramidon (aminopyrine) and in the conversion of $^{14}CCl_4$ into $^{14}CO_2$. The incorporation of ^{14}C-leucine into protein by liver slices was depressed by CCl_4. This effect was decreased by addition of SKF 525A (2-diethylaminoethyl 2,2-diphenyl-2-propylacetate) and in slices from rats given protein-free diets. It is suggested that the toxicity of CCl_4 is closely linked to its metabolism. (Auth.)

604 Sixma, F. L. J., Hendriks, H., Helle, K., Hollstein, U. MICRO-SYNTHESIS OF CYANIDE FROM BARIUM CARBONATE. Recl Trav. chim. Pays-Bas Belg. 73 (1954) 161-166. (In English)

A new and very simple micro-synthesis of $H^{14}CN$ from $BaCO_3$, ammonium chloride, and potassium is described. Yields of 94±1.5% were obtained. Experiences with some other simple and fast methods described in the literature are reported as well. (Auth.)

605 Vaughan, W.R., McCane, D.I. A CONVENIENT TRANSFORMATION OF RADIOACTIVE CARBON DIOXIDE INTO RADIOACTIVE CYANIDE. J. Am. chem. Soc. 76 (1954) 2504-2505.

This paper reports a procedure which compares favourably with that of Belleau and Heard (J. Am. chem. Soc. 72:1950, 4268) with respect to yield, simplicity of manipulation and rapidity. The chief advantage of the present method over the other is the conversion of the acid to the nitrile in one step. The over-all yield obtainable for the conversion of barium carbonate to NaCN is 67-85%. The synthesis steps are (1) phenylacetic acid-1-^{14}C, to (2) phenylacetonitrile-1-^{14}C, to (3) $K^{14}CN$. The preparation of labelled cuprous cyanide is also described.

606 Voroshtsov, N.N., Koptyug, V.A. DEHYDROGENATION OF ALPHA-TETRALON BY SELENIUM, AND THE SYNTHESIS OF 1-NAPHTHOL-1-^{14}C. Zh. obshch. Khim. 28 (1958) 2981-2987. (In Russian)

On heating α-tetralon with selenium to 330°C for 10 h it was converted to asymmetric dinaphtho-(1',2' : 2,3; 1'',2'' : 4,5)-furan, with a 12.2% yield) and simultaneously dehydrogenated to form 1-naphthol (with a 31% yield). Triethylamine was used in the separation of HBr from 2-bromine-1-keto-1,2,3,4-tetrahydronaphthalene, and to effect the formation of 1-naphthol with a much greater (75-76%) yield than in the case of diethylaniline. 1-naphthol-1-^{14}C was synthesised from 1-keto-1,2,3,4-tetrahydronaphthalene-1-^{14}C, with a 63.5% yield.

607 Balazs, T., Kupfer, D. EFFECT OF DDT ON THE METABOLISM AND PRODUCTION RATE OF CORTISOL IN THE GUINEA PIG. Toxic. appl. Pharmac. 9, 1 (1966) 40-43.

The effects of a technical grade and a recrystallized sample of p,p'-DDT on the metabolism and production rate of cortisol in guinea pigs were investigated (cortisol-^{14}C). Daily oral administration of 150 mg/kg of technical grade DDT stimulated the formation of urinary polar cortisol metabolites within 1 week. Recrystallized p,p'-DDT did not induce such an alteration of cortisol metabolism. The production rate of cortisol was not altered significantly during the period investigated. (Nucl. Med.)

608 Barker, P.S., Morrison, F.O. THE BASIS OF DDT TOLERANCE IN THE LABORATORY MOUSE. Can. J. Zool. 44, 5 (1966) 879-887.

DDT tolerance in the Macdonald strain of the laboratory mouse is shown to be related to lipid content. Relatively large amounts of sesame oil injected into DDT-treated mice, either with the DDT or up until the symptoms of poisoning appeared, protected the recipients from severe symptoms and death. DDT-tolerant mice excreted ^{14}C-labelled DDT or its metabolites in the urine, at a significantly lower rate than the normal mice. DDT-susceptible mice excreted 8-10% of the injected dose of DDT within 12 d. DDT tolerance could not be related to the production of DDE or TDE. (Nucl. Med.)

609 Bogner, R.L. DEVELOPMENT OF DOUBLE ISOTOPE DERIVATIVE ASSAYS FOR MEASUREMENT OF PESTICIDE RESIDUES. p.67-77 of "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel, Vienna, Austria, 12-16 Apr, 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria). 1966, 118p.

Double isotope derivative assay methods are capable of providing a high degree of accuracy, precision, sensitivity and specificity for the microanalysis of pesticide chemical residues. Quantitative analysis is thus possible without quantitative separation, provided that qualitative isolation of the component of interest in high purity is possible. The procedures also serve as a confirmatory test of structure, and are therefore more selective and discerning than rapid gas chromatographic routines. Double-labelled $^{3}H/^{14}C$ TNDDTA [the dianilide form of TNDDT, the tetranitrated derivative of DDT, 1,1,1-trichloro-2,2-bis(4-chloro-3,5-dinitrophenyl)ethane] was prepared for the early stages of the work during which the paper and column chromatographic behaviours of ^{14}C-DDT, ^{3}H-aniline, ^{14}C-TNDDT and the double-labelled derivative were investigated. A method was devised for the double isotope derivative dilution analysis for DDT. The ratio of $^{3}H/^{14}C$ was determined by liquid scintillation spectrometry. The amount of non-radioactive DDT in each sample was calculated by the formula

$$\mu g\ DDT = \frac{x\,(R_2 - R_1)}{R_1}$$

where x = μg of ^{14}C-DDT added to each sample, R_1 = ^{3}H/^{14}C ratio of the standard derivative, and R_2 = ^{3}H/^{14}C of the sample derivative. A double isotope derivative analysis may be used for simultaneously determining DDT and DDE. – Dieldrin was also amenable to analysis which involving derivatization of ^{14}C-dieldrin with acetic-^{3}H anhydride and purification of the double-labelled derivative by multiple recrystallizations with carrier. (The double-labelled ^{3}H/^{14}C DBA (6-acetoxy-7-bromo-6,7-dehydroaldrin) was prepared by microsynthesis from dieldrin-^{14}C and acetic-^{3}H anhydride. Multiple recrystallizations with DBA carrier from methanol-water and finally methanol proved to be the only way in which a theoretical ratio of ^{3}H/^{14}C of the reaction product could be obtained. - The preparation of a stable derivative was not successful with diazinon.

610 Bracha, P., O'Brien, R.D. THE RELATION BETWEEN PHYSICAL PROPERTIES AND UPTAKE OF INSECTICIDES BY EGGS OF THE LARGE MILKWEED BUG. J. econ. Ent. 59, 5 (1966) 1255-64.

Eggs of the large milkweed bug, Oncopeltus fasciatus (Dallas), were exposed to vapours of ^{3}H- or ^{14}C-labelled insecticides, including organophosphates, carbamates, and chlorinated hydrocarbons. 1,1,1-trichloro-2,2-bis(p-chloro-^{14}C-phenyl) ethane (^{14}C-DDT) in benzene solution at 4.35 mCi/mM; 1,2,3,4-^{14}C-dieldrin in benzene solution at 9.4 mCi/mM; diisopropyl-1-^{3}H-phosphorofluoridate (^{3}H-DFP, 1 Ci/mM); S-[1,2-bis(ethoxycarbonyl)ethyl-1,2-^{14}C] O,O-dimethyl phosphorodithioate (^{14}C-malathion, 2.87 mCi/mM); o-(isopropoxy-1,3-^{14}C) phenyl methylcarbamate (10.2 mCi/mM) (^{14}C-Baygon®); 2,2-dichlororovinyl dimethyl phosphate (^{14}C-dichlorvos, 1.8 mCi/mM); O,O-dimethyl O-[p-(dimethylsulfamoyl)-^{3}H-phenyl] phosphorothioate (^{3}H-famphur, 78.3 mCi/mM); ^{3}H-O,O-dimethyl S-(N-methylcarbamoylmethyl) phosphorothioate (^{3}H-dimethoate, 50 mCi/mM); and ^{3}H-1-naphthyl methylcarbamate (^{3}H-carbaryl, 2.5 mCi/mM) and ^{3}H-3,5-diisopropylphenyl N-methylcarbamate (^{3}H-DIP, 7.4 mCi/mM) both labelled on their aromatic nucleus, were used. The amount of the compound picked up by the egg from the vapour phase and subsequently reaching the embryo was governed by the combined effects of the compound's vapour pressure and its partition coefficient, measured in an olive oil-water system. The egg's relative insensitivity to parathion as compared with dichlorvos was due to a large uptake of the latter by the embryo. Upon exposure of the eggs to compounds of similar partition coefficients the uptake was a linear function of the vapour pressure. Similarly, with compounds having a vapour pressure lower than a threshold value, uptake was directly proportional to their partition coefficient. True ovicidal action was observed only with those compounds which had a markedly high vapour pressure coupled with little lipophilic character: dichlorvos, DFP (diisopropyl phosphorofluoridate), and, at high doses, o-isopropoxyphenyl methycarbamate (Baygon®).

611 Brooks, G.T. PROGRESS IN METABOLIC STUDIES OF THE CYCLODIENE INSECTICIDES AND ITS RELEVANCE TO STRUCTURE-ACTIVITY CORRELATIONS. Wld Rev. Pest Control 5, 2 (1966) 62-84.

Review article. Since the emergence of insect resistance to cyclodiene insecticides and in view of pesticide resistance problems, the fate of these compounds in living organisms has come under close scrutiny. A summary of the present status of these investigations and a correlation between some of the findings with observed toxicities are attempted. – In vivo and in vitro studies of the commercially important cyclodiene insecticides and of cyclodiene analogues of intermediate or low toxicity are reviewed. Extensive use has been made of radioisotopes in many of the studies cited. Structure-activity considerations are also dealt with in some detail.

612 Brower, G.R. OZONATION REACTIONS OF SELECTED PESTICIDES FOR WATER POLLUTION ABATEMENT. Diss. Abstr. 28, 2 (1967) 722-B.

Saturated solutions of the pesticide aldrin were chemically oxidized by ozone. The results of gas chromatographic analyses showed that 95% of the aldrin was degraded to other compounds within 5 min. The ozonation to this extent only required about 3.7 mg/l ozone but even after prolonged ozonation, which amounted to 23.8 mg/l, there was still aldrin present. The rate of aldrin degradation reached a plateau beyond which little or no degradation occurred. The reaction in each case failed to go to completion. A ^{14}C-labelled sample of aldrin showed that no physical stripping occurred through the ozonation procedure. The characterization methods showed that the aldrin molecule was not degraded to simple inorganic molecules of the most oxidized form. Instead, indications were that half of the atoms of the original molecules were still intact after oxidation. These were the atoms on the chlorinated side of the molecule. The carbon-carbon double bond and all the chlorine atoms were probably still present. The physiological tests indicated that a saturated

solution of aldrin dissolved in a water supply can be rendered less toxic by ozonation. The ozonated products of aldrin oxidation were shown to be less toxic than aldrin to bluegill fingerlings. (From DA)

613 Chung, R.A., Huang, I.L., Brown, R.W. STUDIES OF DNA, RNA, AND PROTEIN SYNTHESIS IN HELA S CELLS EXPOSED TO DDT AND DIELDRIN. J. agric. Fd Chem. 15, 3 (1967) 497-500.

HeLa S cells were cultured in the presence of different levels of DDT and dieldrin. In the first (second) set of experiments using DDT (dieldrin) the cultures were incubated at 36°C for 24 h (48 h) following the addition of 0.1 μCi of L-leucine-^{14}C, 0.5 (0.25) μCi of thymine-^{14}C, or 0.5 (0.25) μCi of uridine-^{14}C. The total cell count decreased as DDT concentration in the culture medium was increased from 0-0.5 ppm, and this decrease became progressively less towards 50 ppm despite the lack of change in total protein content. When DDT and dieldrin concentrations were increased to 0.5 ppm ^{14}C-leucine incorporation into cellular protein increased but decreased as the DDT and dieldrin concentrations were increased to 10 and 50 ppm. The degree of change with dieldrin was less than with DDT. The changes in RNA synthesis at different DDT levels were similar to those at different dieldrin levels but dieldrin had a greater effect. At 10- and 50-ppm DDT and dieldrin levels, DNA synthesis changed very little.

614 Clark, A.G., Hitchcock, M., Smith, J.N. METABOLISM OF GAMMEXANE IN FLIES, TICKS AND LOCUSTS. Nature, Lond. 209 (1966) 103.

Gas chromatographic analyses of cattle ticks (Boophilus decoloratus) kept at 35°C overnight showed that only 77% (64-96%) of a 10 μg topical dose of gammexane was recoverable unchanged. In similar experiments with ^{14}C-gammexane 28% (8-30%) of the dose was found in the water-soluble fraction after partitioning the homogenized ticks between water and xylene. Enzymatic experiments were carried out with homogenates of cattle ticks, house flies, or locust fat body containing 5 mM glutathione at pH values between 5 and 8 and with sufficient ^{14}C-gammexane to give a concentration of 5 mM. Water-soluble radioactive products were only formed when both glutathione and enzyme were present. — The major metabolic product in all three arthropods proved to be an aromatized molecule, apparently identical with S-(2,4-dichlorphenyl)glutathione. The metabolism of gammexane is discussed.

615 Cline, R.E., Pearce, G.W. SIMILAR EFFECTS OF DDT AND CONVULSIVE HYDRAZIDES ON HOUSEFLY METABOLISM. J. Insect Physiol. 12 (1966) 153-162.

Thiocarbohydrazide (TCH) was the most toxic of numerous convulsants tested in house flies and was as toxic to a DDT-resistant strain as to a susceptible strain. The LD 50 values ranged from 0.3 μg/fly for injected aqueous TCH to 1 μg/fly for TCH dissolved in dimethylsulphoxide and benzene and applied topically. The in vivo tracer studies with formate-^{14}C revealed that both DDT and TCH increased the labelling of purines while reducing the content of radioproline. Both toxicants stimulated the production of $^{14}CO_2$ from ^{14}C-labelled proline and sugars, the increase from glucose-1-^{14}C being almost double that from glucose-6-^{14}C. D-glucosamine-1-^{14}C, D-glucose-1-^{14}C, -6-^{14}C, -U-^{14}C, DL-proline-5-^{14}C, and L-proline-U-^{14}C were used. Other similar effects of the toxicants involve the metabolism of 1-carbon compounds in the presence of azaserine and urea production from arginine. The following labelled compounds were used in this series of experiments: L-alanine-1-^{14}C; γ-aminobutyric acid-1-^{14}C; L-arginine, guanidino-^{14}C; DL-aspartic acid-3-^{14}C; n-butyric acid, sodium-3-^{14}C; caproic acid, sodium-1-^{14}C; L-citrulline, ureido-^{14}C; L-glutamic acid-U-^{14}C; L-glutamine-U-^{14}C; glycine-1-^{14}C; glycine-2-^{14}C; hydroxyproline-2-^{14}C; α-ketoglutaric acid, sodium-5-^{14}C; L-leucine-1-^{14}C; octanoate, sodium-1-^{14}C; DL-ornithine-5-^{14}C; L-phenylalanine-1-^{14}C; pyruvate-3-^{14}C; sarcosine, methyl-^{14}C; thymine, methyl-^{14}C; and DL-tryptophane-3-^{14}C. Inverse metabolic effects exerted by DDT in the susceptible and resistant strains are discussed.

616 Cope, O.B. AGRICULTURAL CHEMICALS AND FRESH-WATER ECOLOGICAL SYSTEMS. p.115-127 of "Research in Pesticides. Proceedings of the Conference on Research Needs and Approaches to the Use of Agricultural Chemicals from a Public Health Viewpoint, Davis, Calif., USA, 1-3 Oct. 1964". Chichester, C.O., Ed. New York, Academic Press. 1965, 380p.

— — — A microenvironment at Denver with ^{14}C-labelled DDT was studied to learn about the fate of 20 bbp of the insecticide in each of four aquaria containing mud, vegetation, soil, bluegill sunfish, and snails of the genus Ampullaria (unpublished data, Fish-Pesticide Research Laboratory). After 14 d, the water contained 0.42 bbp, the soil 6 bbp, and the vegetation 15 600 bbp. Two weeks

after the fish were added, they contained 1000 bbp; the snails built up to 160 bbp in two weeks. Here, the entire environment apparently contributed to the decline of the DDT in the water. – – – (Cited verbatim, on p. 125)

617 Crosby, D.G. et al. CHEMISTRY AND TOXICOLOGY OF NON-METABOLIC DECOMPOSITION PRODUCTS OF PESTICIDES. Univ. Calif. Food Protect. and Toxicol. Ctr. Ann. Rpt. (1966) 48-50.

Products of dieldrin and aldrin formed by exposure to sunlight, ultraviolet and irradiation have been studied.

618 Dedek, W., Koch, H., Wenzel, K.D. ZUR DARSTELLUNG VON ^{3}H-MARKIERTEM CHLORAL. (Regarding the preparation of ^{3}H-labelled Chloral.) Atompraxis 13, 6 (1967) 256-257. (In German, with English and French summaries)

Chloral (trichloracetaldehyde) has become important as a step in the production of certain insecticides (DDT, trichlorphon, DDVP). The preparation and purification of ^{3}H-Chloral by the Wilzbach method is described. The specific activity of the purified product is 1.5 mCi/g ≈ 0.25 mCi/mM. Other methods for direct labelling by ^{3}H proved unsatisfactory.

619 Deema, P., Thompson, E., Ware, G.W. METABOLISM, STORAGE, AND EXCRETION OF C^{14}-ENDOSULFAN IN THE MOUSE. J. econ. Ent. 59 (1966) 546-550.

A portion of endosulfan, when fed to the laboratory mouse in single or multiple doses, is oxidized to the cyclic sulfate and stored in the body fat. No endosulfan per se, or any of the known metabolites are found in tissues or organs except the liver and kidney, both of which are involved in the metabolism and excretion. Purified endosulfan is not completely absorbed from the gastrointestinal tract, and is eliminated in the faeces with two metabolites, the diol and sulfate. A metabolite appearing in the urine of mice fed either endosulfan, the sulfate, the diol, or the ether is believed to be the diol. The relative activities of organs and excreta of mice sacrificed 24 h after ingesting ^{14}C-endosulfan were: faeces > visceral fat > urine > liver > small intestine plus contents > kidney > brain > respiratory CO_2 > blood. The endosulfan had a specific activity of 0.577 μCi/mg and was labelled in the hexachlorocyclodiene ring at carbons 5 and 6.

620 Dindal, D.L. KINETICS OF Cl^{36} DDT IN WILD WATERFOWL. Diss. Abstr. 28, 3 (1967) 1267-8.

The ingestion rate, metabolism, storage, and excretion of radio-labelled ^{36}Cl-DDT in wild mallard ducks Anas platyrhynchos and lesser scaup ducks Aythya affinis was investigated for two years. A single application of the tagged pesticide was applied to a marsh at the rate of 0.2 lb/A, a level used for mosquito control. A total of 112 ducks was introduced, exposed to the DDT, and collected after various exposure periods. Twenty-three tissues and organs per duck were assayed for DDT residues using liquid scintillation spectrometry, electron capture gas chromatography, thin-layer chromatography, and microautoradiography analysis methods. Liquid scintillation spectrometry was the most reliable quantitative analysis method. A total of 3840 samples were processed by all of these methods. Residues of DDT were found at some time in all tissues tested, except the testes of lesser scaup. Lesser scaup thyroids, spleen, testes, and ovaries contained no detectable residues during the 2nd year. The compounds DDE, DDD, and DDT were most common, but DDE was the predominant metabolite found throughout the 2-yr period. DDMU was recovered from the liver and brain of both species. Metabolite concentrations are given for all tissues sampled. Definite relationships exist between the quality of food ingested (plant or animal) and the kinetics of DDT residues. This is reflected in the residue level differences between mallards and lesser scaup. Levels in all scaup tissues were generally higher than those of mallard tissues. In both species some of the highest residue concentrations were found in leg and neck fat, uropygial glands, and adrenal glands. Dynamics of equilibrium storage and excretion of DDT residues were also observed. (DA)

621 Duffy, J.R.H. THE SYNTHESES OF ETHANE-LABELLED DDT AND o-Cl-DDT AND THEIR METABOLISM IN LARVAL Aedes aegypti. Diss. Abstr. 25, 3 (1964) 1562-1563.

The compounds DDT-1-^{14}C, DDT-2-^{14}C, o-Cl-DDT-1-^{14}C and o-Cl-DDT-2-^{14}C were synthesised and their metabolism studied in larvae of the yellow fever mosquito, Aedes aegypti. The ethylenic derivatives of the above compounds were also synthesised and used as reference standards for radiochromatography of the metabolic products. As a source of radiocarbon, barium carbonate-^{14}C was employed. Carbon-dioxide-^{14}C was generated and reduced to methanol-^{14}C, using lithium alu-

minium hydride. Methanol-^{14}C was converted to methyl-^{14}C iodide with hydrogen iodide. The Grignard reagent, methyl-^{14}C magnesium iodide was made and reacted with p-chlorobenzaldehyde to form 1-(p-chlorophenyl)-ethanol-2-^{14}C. This alcohol was oxidized to 4-chloroacetophenone-2-^{14}C with chromic acid. The ketone was chlorinated at 210° with elemental chlorine to yield 2,2,2,4'-tetrachloroacetophenone-2-^{14}C, which was reduced to 1-(p-chlorophenyl)-2,2,2-trichloroethanol-2-^{14}C with lithium aluminium hydride. This alcohol was condensed with chlorobenzene, in the presence of sulfuric acid, to give DDT-1-^{14}C. Another portion of the same alcohol was condensed with m-dichlorobenzene to give o-Cl-DDT-1-^{14}C. DDE-1-^{14}C and p-Cl-DDE-1-^{14}C were prepared by the dehydrochlorination of DDT-1-^{14}C and o-Cl-DDT-1-^{14}C. DDT-2-^{14}C and o-Cl-DDT-2-^{14}C were also synthesised starting with barium carbonate-^{14}C. Carbon dioxide-^{14}C was generated and reacted with p-chlorophenylmagnesium bromide to yield p-chlorobenzoic-carboxy-^{14}C acid, which was converted to the acid chloride with thionyl chloride. The acid chloride was then condensed with ethyleneimine to give N-(p-chlorobenzoyl-carbonyl-^{14}C)-aziridine. This was reduced with lithium aluminum hydride to form p-chlorobenzaldehyde-formyl-^{14}C. Chloroform was added to this aldehyde in the presence of potassium hydroxide, dissolved in ethylene glycol monoethyl ether, to yield 1-(p-chlorophenyl)-2,2,2-trichloroethanol-1-^{14}C. A portion of the alcohol was condensed with chlorobenzene to give DDT-2-^{14}C. Another portion of the same alcohol was condensed with m-dichlorobenzene to yield o-Cl-DDT-2-^{14}C. The corresponding ethylene derivatives were prepared as previously described. In larval A. aegypti, as in adult house flies, DDE proved to be the only detectable metabolite of DDT. Thus, the radiochromatography confirmed the results previously reported by Abedi and Brown, who used ring-labelled DDT. No water-soluble metabolites in the insect bodies or in the excreta were detected. In the larvae of A. aegypti, o-Cl-DDE proved to be the only detectable metabolite of o-Cl-DDT. Resistant mosquito strains were able to dehydrochlorinate o-Cl-DDT only slightly more than susceptible strains and at a lower rate than that at which they dehydrochlorinated DDT. No water-soluble metabolites of o-Cl-DDT were found in the insect bodies or excreta. DMC proved to be synergistic with DDT and o-Cl-DDT for resistant, but not for susceptible strains of mosquito larvae. The production of DDE and o-Cl-DDE by resistant strains was reduced by DMC, which also appeared to have the effect of reducing the absorption of DDT and o-Cl-DDT. (DA)

622 Eaton, J.L. TEMPERATURE AND THE ACTION OF DDT ON THE COCKROACH NERVOUS SYSTEM. Diss. Abstr. 27, 11 (1967) 4097-B - 4098-B.

Studies were made to locate the site responsible for the negative temperature coefficient of toxicity indicated by the visible symptoms of poisoning in DDT-treated insects, and to determine the role of DDT in the negative temperature coefficient of toxicity. Experiments using ^{14}C-DDT have shown that the patterns of activity observed in abdominal central nervous system (CNS) of DDT-treated cockroaches are not directly related to the amount of ^{14}C-DDT in the CNS. High levels of afferent activity appear to be more important than is the amount of DDT present, for the production of high levels of activity in the CNS. It is concluded that impaired synaptic transmission is the cause of the negative temperature coefficient of toxicity in DDT-treated insects. It appears that DDT does not act directly to cause this impairment. A suggestion is made that high afferent activity at low temperatures causes the DDT-toxin or a chemical transmitter to accumulate at the synapse, and ultimately a concentration of toxin or transmitter is reached which causes synaptic impairment and conduction block.

623 Eaton, J.L., Sternburg, J.G. UPTAKE OF DDT BY THE AMERICAN COCKROACH CENTRAL NERVOUS SYSTEM. J. econ. Ent. 60, 6 (1967) 1699-1703.

Experiments using ^{14}C-DDT to relate the DDT content of the central nervous system (CNS) to frequency of appearance of DDT-induced trains indicate that the DDT content of the CNS is not directly related to the levels of nerve activity observed. After either small injected dosages of ^{14}C-DDT or large topical dosages of ^{14}C-DDT applied to the cerci, a larger number of DDT-induced trains appear in the abdominal CNS of the topically treated cockroaches. In contrast, the ^{14}C-DDT content of the abdominal CNS of the topically treated American cockroach, Periplaneta americana (L.), is actually less than the amount in the abdominal CNS of the cockroaches treated by injection. Thus, it seems that high levels of afferent activity are more important than the amount of DDT in the abdominal CNS for the production of high levels of activity in the abdominal CNS. When 0.107 ng of DDT in suspension is injected into the sixth abdominal ganglion no DDT trains are produced. When ten times this dosage is injected into the sixth abdominal ganglion DDT trains are produced in the

abdominal CNS. Observation of the frequency of appearance of DDT-induced trains at different temperatures reveals a relationship identical to that found in sensory nerves. That is, as temperature is increased, the frequency of appearance of DDT-induced trains in the abdominal CNS is also increased. Thus when the effect of DDT in the abdominal CNS is studied in the absence of high levels of afferent input, the relationship between the effect of DDT on nerve and temperature is the direct relationship which is obtained with sensory nerves, and not the inverse relation to temperature found in vivo with afferent input intact but subject to the action of DDT. (Auth.)

624 El Basheir, S. CAUSE OF RESISTANCE TO DDT IN A DIAZINON-SELECTED AND A DDT-SELECTED STRAIN OF HOUSE FLIES. Entomologia exp. appl. 10 (1967) 111-126.

The causes of resistance to DDT in a DDT-selected (F58W) and a diazinon-selected (SKA) strain of house flies differed. Small (1 μg DDT/fly) topically applied doses penetrated more slowly into the SKA than into the F58W or susceptible strains. Large doses (32 μg/fly) penetrated equally fast into all strains. The two resistant strains metabolised DDT rapidly and the susceptible strain slowly. The only metabolite identified was DDE. WARF anti-resistant is a powerful synergist for DDT in the F58W strain, and prevents the formation of DDE. WARF anti-resistant is not such a good synergist in the SKA strain which possesses other mechanisms for merabolising DDT and also DDE. DDT or its decomposition products seem to interact strongly with the tissues of SKA flies from which they are not readily extracted. The radioactive DDT used in some experiments was labelled in the benzene ring with ^{36}Cl, and had a specific activity of 120 μCi/g.

625 Fine, B.C., Letelier, M.E., Agosin, M. EFFECT OF VARIOUS SYNERGISTS ON TOXICITY AND IN VIVO METABOLISM OF DDT IN Triatoma infestans NYMPHS. Expl Parasit. 19, 3 (1966) 304-309.

Piperonyl butoxide and Sesoxane were the most effective synergists of DDT against T. infestans nymphs. They increased the toxicity of DDT by a factor of >20. The synergists inhibited the oxidative detoxication of ^{14}C-labelled DDT to more polar metabolites. Neither N, N-dibutyl-p-chlorobenzenesulfonamide (Warf-antiresistant, WARF) nor 2,2-bis(p-chlorophenyl)ethanol inhibited the conversion of DDT to 2,2-bis(p-chlorophenyl)-1,1-dichloroethylene (DDE). (CA 66: 1967, 85035a)

626 Forman, S.E., Graham, J.R. AUTORADIOLYSIS OF 6,7,8,9,10,10-HEXACHLORO-1,5,5a,6,9,9a-HEXAHYDRO-6,9-METHANO-2,4,3-BENZODIOXATHIEPINE 3-OXIDE-5a,9a-C^{14}. J. org. Chem. 29 (1964) 233-235.

The autoradiolysis behaviour of ^{14}C-labelled samples of the insecticide Thiodan is reported. The spectra of radio-Thiodan showed the presence of Thiodan ether only after 2.5-yr storage. Infrared spectral analysis indicated that the ratio of higher melting to lower melting Thiodan isomers in the radioactive samples increased from the ratio that was present shortly after preparation. The possible mechanism of autoradiolysis of Thiodan is discussed. (NSA 18: 1964, 8414)

627 Fumarola, D., Giordano, D., Pantaleo, R. QUANTITATIVE STUDY OF THE DISTRIBUTION OF Au^{198} DURING EXPERIMENTAL PLASMOCYTOSIS FROM DDT. Medna exp. 10, 4 (1964) 245-259.

An investigation was carried out as to whether an experimental plasmocytic state of the RES induced in albino rats and rabbits by the administration of DDT, could reflect quantitatively on the functional activity of this system studied by means of the uptake of ^{198}Au. The results obtained provided evidence that the quantitative distribution of radio-gold examined in the various tissues showed significant differences between normal animals and animals with plasmocytosis from DDT. In the tissues with marked plasmocytosis (spleen in the rabbit, thymus and bone marrow in the rat) the phagocytic activity against radio-gold was very reduced. There was a correlation between the plasmocytic change of the RES and the modification of the storage capacity of the ^{198}Au. (Nucl. Med.)

628 Fumarola, D., Giordano, D., Pantaleo, R. QUANTITATIVE STUDY OF THE DISTRIBUTION OF ^{198}Au DURING EXPERIMENTAL PLASMOCYTOSES FROM DDT. Sangre, Barcelona 9, 1 (1964) 127-130.

Significant differences in radio-gold uptake were found between normal animals and animals with plasmocytosis from DDT. There appeared to be a correlation between the state of the RES and

modification of the storage capacity of the ^{198}Au. The modification or morphological and functional state of the RES determined by this experimental condition and its capacity of reversibility with the cessation of the administration of the determinant substance, again demonstrates the great adaptability of this system to different agents. (Nucl. Med.)

629 Gakstatter, J.H. THE UPTAKE FROM WATER BY SEVERAL SPECIES OF FRESH-WATER FISH OF p, p'-DDT, DIELDREN AND LINDANE: THEIR TISSUE DISTRIBUTION AND ELIMINATION RATE. Diss. Abstr. 27, 11 (1967) 3820-B.

The uptake from water, tissue distribution and elimination rate of p,p'-DDT, dieldren and lindane by several species of fresh-water fish was investigated, using ^{14}C-labelled insecticides of known specific activities. Bluegills (Lepomis macrochirus), goldfish (Carassius auratus), redears (Lepomis microlophus) and white catfish (Ictalurus catus) were exposed to sub-lethal concentrations of the above insecticides and were then allowed to recover over periods up to 41 d. Insecticide concentrations in the tissues were determined by direct dissolution in 0.4 N NCS followed by liquid scintillation counting. The rate of removal of insecticide from water by fish was in the decreasing order of DDT, dieldren and lindane. The differences were attributed to the relative degrees of solubility in water of the three compounds. The need for the use of continuous renewal bioassay systems was emphasised. DDT, dieldren and lindane were distributed in varying amounts to all tissues during short sub-lethal exposures. Insecticide concentrations in the visceral fat greatly exceeded those in any other tissues. Muscle concentrations were low. High concentrations in the liver, gall bladder, pyloric caeca and intestine were related to excretion by this route. In the first 24 h during recovery from a sub-lethal exposure, a general redistribution occurred which resulted in higher visceral fat and generally lower concentrations in other tissues. Mature goldfish ovaries were not found to act like fat in their accumulative capacity. Greater accumulations of DDT were noted in the testes rather than the ovaries of goldfish. Significant differences were found in the elimination rates of DDT, dieldren and lindane from fish. More than 90% of the accumulated lindane was eliminated from the fish after 2 d of recovery from a sub-lethal exposure, >90% of the accumulated dieldren within 16 d, whereas < 50% of DDT was eliminated within 32 d. DDT, dieldren and lindane were found to be readily transferred from contaminated to uncontaminated fish in the recovery aquaria. This may account in part for the residues of DDT which are found in aquatic organisms from areas with no past history of DDT use. (From DA)

630 Gakstatter, J.H., Weiss, C.M. THE ELIMINATION OF DDT-^{14}C DIELDRIN-^{14}C, AND LINDANE-^{14}C FROM FISH FOLLOWING A SINGLE SUBLETHAL EXPOSURE IN AQUARIA. Trans. Am. Fish. Soc. 96, 3 (1967) 301-307.

Groups of 60-70 small bluegills (Lepomis macrochirus) and goldfish (Carassius auratus) were exposed in polyethylene tanks to 0.03 ppm of DDT-^{14}C, dieldrin-^{14}C, or lindane-^{14}C for periods ranging from 5-19 h. Following the exposure, the fish were rinsed and placed with unexposed fish 145-ℓ aquaria in which the water was continuously renewed at the rate of 2.5 changes per day. The initial lindane-^{14}C was eliminated by both species of exposed fish within 2 d. More than 90% of the initial dieldrin-^{14}C was eliminated in the first two weeks of recovery. Less than 50% of the DDT-^{14}C was eliminated after 32 d of recovery. Labelled DDT and dieldrin were readily transferred from contaminated fish to uncontaminated fish in the recovery aquaria. (CA 67: 1967, 90043b)

631 Grant, C.D., Brown, A.W.A. DEVELOPMENT OF DDT RESISTANCE IN CERTAIN MAYFLIES IN NEW BRUNSWICK. Can. Ent. 99, 10 (1967) 1040-1050.

Populations of the mayfly Heptagenia hebe McDunnough in areas of New Brunswick were air-sprayed with DDT for budworm control for 8 successive years. When tested as nymphs taken from the streams, they showed LC50 levels three times as high as those in untreated areas. Populations surviving an air-spray in 1965 proved to be 12-40 times as DDT-resistant as the normal. Pre-spray populations of Stenonema fuscum (Clemens) showed a 5-fold resistance, and post-spray populations of S. interpunctatum (Say) showed a 10-fold DDT resistance when those from treated areas were compared with those from untreated. The uptake and metabolism of ^{14}C-DDT was studied by exposing nymphs to 0.2 ppm ^{14}C-DDT for 18.5 h, and then grinding them with sand and sodium sulphate. For assessment of uptake, the ground tissues were extracted with petroleum ether, and transferred to a 6 in. x 0.5in. chromatographic column of Woelm alumina: the absorbed ^{14}C-DDT was then eluted. The separation of ^{14}C-DDE is also described. The DDT-resistant nymphs of H. hebe detoxified DDT to DDE 15 times

faster than the normal nymphs; DDE was also the metabolite in S. interpunctatum. In both these species the DDT-resistant nymphs absorbed roughly twice as much DDT as the normal.

632 Guenzi, W.D., Beard, W.E. ANAEROBIC BIODEGRADATION OF DDT TO DDD IN SOIL. Science, N.Y. 156 (1967) 1116-1117.

^{14}C-DDT was added to soil and the mixture incubated anaerobically for 2 weeks and 4 weeks. DDT and seven possible decomposition products were separated by thin-layer chromatography, and the radioactivity of material from individual spots was determined by liquid scintillation. The DDT was dechlorinated by soil microorganisms to DDD, and only traces of other degradation products were detected. No degradation of DDT was detected in sterile soil. (Essentially auth.)

633 Gunther, F.A., Hylin, J.W., Spenger, R.E. NATURE OF CHLORINE INTERFERENCES IN TOTAL HALOGEN METHODS OF ANALYSIS OF ORGANOCHLORINE PESTICIDE RESIDUES IN PLANTS. J. agric. Fd Chem. 14, 5 (1966) 515-519.

The source of a widely distributed background-organochlorine compound, which interferes with the determination of organochlorine pesticide residues in plant parts by any total halogen methods, has been tentatively identified as being due to quaternary chloride salts of lecithins. The degree and extent of interference vary from species to species of plant, among samples of the same species, and among parts of the same plant. These differences are due largely to variations in concentrations of certain plant constituents at the time of sampling but, also, reflect some effects due to sample storage and processing procedures that may cause lecithin degradation. — $Ca^{36}Cl$ was injected into developing roots of beet plants. Data are tabulated on hexane-extractable Cl in some wild and cultivated plants (determined by combustion and by neutron activation); the distribution of ^{36}Cl in extracts of table beet tops, and in eluates from silicic acid chromatography of hexane extracts of beet leaves; on the phospholipid contents of eluates from silicic acid chromatography of beet leaves; the extraction of hexane-soluble ^{36}Cl by several reagents; the release of hexane-soluble ^{36}Cl by phospholipase D; and on the partial analysis of plant constituents extracted by hexane.

634 Harvey, J.M. EXCRETION OF DDT BY MIGRATORY BIRDS. Can. J. Zool. 45, 5 (1967) 629-633.

Juvenile starlings were fed peas containing a total of 4.75 mg DDT (a mixture of ^{14}C-labelled and carrier DDT) each day for 5 d. After this time, two birds were killed every other day for 12 d and then every 3rd day for 6 d. The brain, liver, and remaining carcass of each bird were extracted separately for fat-soluble pesticide. The concentration of the insecticide remained high in the body and liver for one week after the feeding period, but decreased more quickly in the brain. After 10 d, less than 10% of the ingested DDT remained in the bird. (CA 67: 1967, 116098q)

635 Hatanaka, A., Hilton, B.D., O'Brien, R.D. THE APPARENT BINDING OF DDT TO TISSUE COMPONENTS. J. agric. Fd Chem. 15, 5 (1967) 854-857.

Sephadex chromatography of tissue homogenates incubated with ^{14}C-DDT provided apparent evidence of binding of DDT with cockroach nerve cord and rat liver, muscle, and brain. Binding was not localized in any particular subcellular fraction of brain. The non-toxic analogues DDE and 1,1,1,2-tetrachloro-2,2-bis(p-chlorophenyl) ethane were equally effective in such binding. Triton X-100 was more effective than tissue homogenates in permitting passage of DDT through Sephadex. Electrophoresis of brain preparations showed no migration of DDT with any fraction. Apparently, evidence for binding based on Sephadex is inadequate in the case of DDT and related compounds. (Auth.)

636 Hathway, D.E., Moss, J.A., Rose, J.A., Williams, D.J.M. TRANSPORT OF DIELDRIN FROM MOTHER TO BLASTOCYST AND FROM MOTHER TO FETUS IN PREGNANT RABBITS. Eur. J. Pharmac. 1, 2 (1967) 167-175.

Investigations were made concerning the problem of transport of an insecticide, dieldrin (I) from mother rabbits to young in utero when the blastocyst was lying free in the uterine cavity (blastogenesis) after implantation, when the development of the main layers and organs was taking place (embryogenesis), and during foetogenesis. Previously the distribution of I was measured between erythrocytes and plasma lipoproteins and proteins in vivo and in vitro. Binding of insecticide to lipoprotein and certain other proteins of the plasma had occurred, free permeability of the erythrocyte

surface to the insecticide was evident, and a very rapid initial rate of removal of I from blood occurred by a roughly logarithmic rate of removal. After single i.v. administration of I-^{14}C to pregnant rabbits, a very small uptake of I by the free blastocysts occurred, followed by equilibration with maternal blood and clearance from the blastocyst. The amount of radioactivity in each blastocyst was equally distributed between embryoplus membranes and the fluid. The rate of I uptake by blastocysts from maternal blood was significantly lower after implantation. I was secreted from the endometria of treated animals irrespective of pregnancy. During the 2nd half of pregnancy, passage of I from mother to foetus was transplacental, allantoic and amniotic fluids being free from ^{14}C. There was a significant interaction between the concentration of I in maternal blood and that in foetal tissues in 16-d pregnant rabbits. The distribution of I between the foetal blood and tissues in 24-d pregnant treated dose was consistent with withdrawal of insectide into foetal liver and fatty tissues. The presence of I in the blood of 24-d pregnant rabbits and non-injected foetuses after injection of a single foetus belonging to each doe afforded unequivocal evidence for 2-d transplacental transport of I. Anesthetization of treated rabbits with Et_2O or fluothane caused a significant increase in I concentration in peripheral blood. (CA 67: 1967, 20963c)

637 Hayashi, M., Matsumura, F. INTERACTIONS OF DDT WITH THE NERVOUS SYSTEM OF THE RESISTANT AND SUSCEPTIBLE GERMAN COCKROACHES. Nature, Lond. 215 (1967) 1510-1512.

A hypothesis has recently been proposed to explain the mode of action of DDT on the basis of charge-transfer complex formation of nerve components with DDT. The strains of Blattella germanica L. used were the CSMA susceptible and the Fort Rucker strain (both LC 50 at 0.0032%), and the London (LC 50 at 0.06%) and the VPI strain (LC 50 at 2%), respectively. ^{14}C-DDT was used. The resistant particulate components proved to have less binding capacity with DDT than do the susceptible components, which is in agreement with the view that a binding difference should exist between the strains at a specific binding site which is related to susceptibility, if such a site is actively engaged in the process of attaining a high level of DDT resistance by the roaches. Resistant roaches could be utilizing this vital process for their advantage. Whether this binding substance can play an indispensable part in DDT poisoning is not yet clear.

638 Hayashi, M., Matsumura, F. INSECTICIDE MODE OF ACTION. EFFECT OF DIELDRIN ON ION MOVEMENT IN THE NERVOUS SYSTEM OF Periplaneta americana AND Blattella germanica COCKROACHES. J. agric. Fd Chem. 15, 4 (1967) 622-627.

Dieldrin initially increased the rate of all ion exchange processes in the nervous tissues of adult males of both American and German cockroaches. ^{22}Na-containing saline was used. After this initial excitation period, sodium ions accumulated in the dieldrin-treated nerve cells while the potassium ion influx decreased. The situation superficially resembles that of DDT poisoning. By means of ^{45}Ca it could be shown that dieldrin also caused a mild condition of hypocalcemia at the late stage of poisoning. This phenomenon, however, does not seem to be causally related to the mode of dieldrin resistance in the German cockroach strains.

639 Heath, D.F. THE RETENTION OF TRIPHENYLTIN AND DIELDRIN, AND ITS RELEVANCE TO THE TOXIC EFFECTS OF MULTIPLE DOSING. p. 18-26 of "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria), 1966, 118p.

The dynamics of the behaviour of dieldrin in rats can be shown to lead to a plausible explanation of the toxic effects observed. ^{36}Cl-dieldrin was slowly infused into rats, to give a total dose of 8-16 mg/kg. Rats showed ample biochemical capacity to metabolise dieldrin, the half-life even with high doses being 11 d after the 1st week. Metabolism is slow because dieldrin is held in fat, which is harmless unless it is released as a consequence of fat mobilization. Toxic effects are related to the amount of dieldrin mobilized. There is no evidence that dieldrin causes an irreversible lesion of the central nervous system. Only preliminary experiments have been carried out with triphenyltin. ^{113}Sn-triphenyltin (specific activity 500 μCi/g) was tested in rats and guinea pigs. In both ^{113}Sn appeared in brain after oral or intraperitoneal dosing, and disappeared fairly slowly. ^{113}Sn would appear to be lost from brain rather faster after i.p. than after oral injection. In both rats and guinea pigs ^{113}Sn persists in brain with "half-lives" of several days. In guinea pigs ^{113}Sn does not appear to be in the form of free stannic ions but it is not necessarily present as triphenyltin. Some of the technical problems involved in isotope dilution experiments on brain extracts from rats are discussed.

640 Jumar, A., Sieber, K., Held, P. INVESTIGATIONS OF THE INSECTICIDE TOXAPHENE USING THE RADIOACTIVE NUCLIDE, ^{36}Cl. Paper presented at the "Radiochemistry Conference, Bratislava, CSSR. 1966, 61p."

A method is reported for semi-micro synthesis of toxaphene (I) labelled with ^{36}Cl, for which a $Na^{36}Cl$-camphene mixture serves as starting material. I thus prepared contains 68% Cl and has a specific activity 50 μCi/g. (CA 68: 1968, 28746a)

641 Jumar, A., Sieber, K. RESIDUE STUDIES IN RAPESEED OIL AND HONEY WITH TOXAPHENE-^{36}Cl. Z. Lebensmittelunters. u. - Forsch. 133, 6 (1967) 357-364. (In German)

Possible hazards in use of toxaphene (I) in rapeseed production would involve residue in the seed oil (used as food oil) or in honey produced by bees in the vicinity. The distribution of the toxaphene was studied using practical applications of toxaphene-^{36}Cl. The oil produced contained 0.3-1.5 mg/kg, and the honey <0.01 mg of I/kg. (CA 67: 1967, 99051k)

1.5.3. Halogenated and other Hydrocarbons

642 Kallman, B.J., Andrews, A.K. REDUCTIVE DECHLORINATION OF DDT TO DDD BY YEAST. Science, N.Y. 141 (1963) 1050-1051.

Labelled DDD [1,1-dichloro-2, 2-bis (p - chlorophenyl) -ethane] was formed from ^{14}C-DDT in the presence of yeast. The formation of DDD from DDE [1,1-dichloro-2,2-bis (p - chlorophenyl) - ethylene] was not observed, indicating that a reductive dechlorination of DDT occurs. (Auth.)

643 Kimura, T., Keegan, H.L., Haberkorn, T. DEHYDROCHLORINATION OF DDT BY ASIAN BLOOD-SUCKING LEECHES. Am. J. trop. Med. 16, 5 (1967) 688-690.

The toxicity of DDT for Southeast Asian buffalo leeches, Hirudinaria manillensis, was tested with a modification of the standard WHO procedures for determining susceptibility-resistance of mosquito larvae to insecticides. Specimens of H. manillensis from Bangkok, Thailand, and Kuala Lumpur, Malaysia, showed a high degree of tolerance. LC 50 values after 120 h continuous exposure were 100 ppm for leeches from Kuala Lumpur and 60 ppm for specimens from Bangkok. The absorption of DDT by specimens of Hirudo nipponia from Japan and of H. manillensis from Malaysia was determined by radioactive assessment of chloroform extracts of leeches that had been exposed for 24 h in aqueous solution containing 7.1 ppm of ring-labelled ^{14}C-DDT. Results showed that 16% of exposed DDT was recovered from H. nipponia, and 17.4% from H. manillensis. After assessment of absorption of DDT by the leeches, the chloroform extracts were evaporated to dryness, taken up in acetone, and chromatographed. The chromatogram of H. nipponia extract showed that 49% of the absorbed DDT had been converted to the nontoxic DDE. Chromatograms of extracts by H. manillensis showed neither production of DDE nor other metabolites of DDT analogues. This, as far as could be determined, was the 1st demonstration of dehydrochlorination of DDT by an annelid. (Auth. summary)

644 Klein, W. Qualitas Pl. Mater. veg. 1967. (In press)

This review article deals with the fate of chlorinated hydrocarbons in insects, other animals, plants and microorganisms, and in soils and water. The insecticides considered particularly are p, p'-DDT, lindane, aldrin, dieldrin, endrin, chlordane, Telodrin, heptachlor, and 3 - dihydroheptachlor. The extensive bibliography of 125 references contains numerous references to studies in which radioisotopes had been used, not always pointed out in the text. - Some unpublished work by Klein, Korte and colleagues is reported on the detoxication of endrin in warm-blooded animals where it takes place very quickly. After intravenous injection of ^{14}C-endrin into rats only hydrophilic metabolites were eliminated in the faeces. Retention 48 h after injection amounted to 65% in males, 78% in females. With daily oral application (30 μg/kg) a saturation level is reached in rats after only 10 d; after 12 d, only 15% of the total activity is retained. The decay curve, after application has ceased, has a half-life of only 2 d. With oral administration, the rate of metabolization is 65-80%.

645 Kochen, W. ISOLIERUNG UND IDENTIFIZIERUNG VON METABOLITEN DES ALDRIN-^{14}C AUS EXKREMENTEN VON KANINCHEN. (Isolation and identification of aldrin-^{14}C metabolites in rabbit excrements.) Thesis, Bonn Univ. (West Germany). 1965, 65 p. (In German)

Rats: - Following intravenous (i.v.) injection of ^{14}C-aldrin, large amounts of hydrophilic metabolites were detected in the excrements, which could be separated by paper- or thin-layer chromatography. The distribution, metabolism and excretion of the labelled insecticide by the rat organism after 48 h was determined. 0.08-0.60% of the injected dose was recovered in the various organs (60-90% of dieldrin). The hydrophilic products occurred in all the organs examined; small amounts of unchanged aldrin were identified. Within 48 h, >18% of the injected dose were eliminated (95% as hydrophilic metabolites) in the excrements. After a single dose of ~20 γ ^{14}C-aldrin, ~55% were eliminated in the faeces within the following 3 weeks. - Rabbits: - Sublethal i.v. dose (~40 mg/rabbit) were largely eliminated in the urine, not in the faeces. Ten male rabbits were given a total of 460 mg ^{14}C-aldrin; within 135 d, 47% had been eliminated in the urine. At least eight metabolites were isolated and partly identified by column and thin-layer chromatography. They are listed below, in order of increasing hydrophilia. Their percentage was determined from column chromatography separation.

Metabolite I - 4%; from infra-red spectrum and R_f value identical with (IF, $R_f \rightarrow$) dieldrin.

Metabolite II - 5%; m.p. 138-139 °C; $C_{12}H_8OCl_6$; IR, $R_f \rightarrow$ 1,2,3,4,10,10, hexachloro-1,4,endo, 5,8, exo dimethano-1,4,4a,5,8,8a,octahydro-7on-naphthaline.

III - 14%; m.p. 161 °C; $C_{15}H_{14}O_4Cl_6$; mol. wt 483; hydrolysis → VII; IF, $R_f \rightarrow$ diacetate of 6,7, transaldrindiol.

IV - 22%; hydrolysis → VII; one OH-group of the trans-6,7, aldrindiol is esterified with anacyl remnant.

V - 4%; not identified.

VI - 3%; m.p. 212 °C; $C_{14}H_{10}O_2Cl_6$; mol. wt 399; OH-groups as cis-isomers.

VII - 43% (and main metabolite); m.p. 131.5 °C; mol. wt 399; $C_{12}H_{10}O_2Cl_6$; optically active (-13.5); IF, $R_f \rightarrow$ synthetic 6,7, trans-aldrindiol.

VIII - 5%; not identified. Two components shown by thin-layer chromatography.

646 Korte, F. METABOLISM OF CHLORINATED INSECTICIDES. p.38-48 of "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel, Vienna, 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria). 1966, 118 p.

In order to study the metabolism of some drin-insecticides in living organisms under comparable conditions, ^{14}C-labelled insecticides of high specific activity needed to be synthesised. Starting with ^{14}C-labelled barium carbonate, ^{14}C-endrin (labelled in the cyclopentene ring), -telodrin (in the 1,3-position), and ^{14}C-aldrin, -dieldrin, -heptachlor, -dihydroheptachlor, and -chlordane (all labelled statistically in the hexachlorocyclopentene ring system) were synthesised. The fate of these insecticides was investigated in three biological organisms: fungi (Aspergillus niger, Penicillium notatum), mosquito (Aedes aegypti) larvae, and mammals (mice, rats). All three proved capable of metabolising them. A fairly large number of metabolites, characterized chromatographically, have so far been isolated. All of them were more hydrophilic than the starting material. Some of them, particularly the main products, are identical, regardless of the organism. Sex differences in metabolism rate, though not in the metabolism product, were observed. In long feeding experiments with rats a saturation level was observed after a certain time, the amount of insecticide remaining in the animal body being excreted after termination of oral application, with a biological half-life period of ~ 11 d for males and 100 d for females.

647 Korte, F., Kochen, W. INSEKTIZIDE IM STOFFWECHSEL. XI. AUSSCHEIDUNG, VERTEILUNG UND UMWANDLUNG VON ALDRIN-^{14}C UND DIELDRIN-^{14}C IN DER RATTE. (Insecticides and metabolism. XI. Elimination, distribution and metabolism of aldrin-^{14}C and dieldrin-^{14}C in the rat.) Med. Pharmacol. exp. 15 (1966) 404-408. (In German, with French and English summaries)

Labelled insecticides were injected intravenously. A steady increase in radioactivity was observed on passing from the liver to the duodenum, intestine, and faeces. The percentage of so-called hydrophilic metabolites increased similarly. This transition was much less noticeable in organs.

648 Korte, F., Kochen, W. INSEKTIZIDE IM STOFFWECHSEL. XII. ISOLIERUNG UND IDENTIFIZIERUNG VON METABOLITEN DES ALDRIN-^{14}C AUS DEM URIN VON KANINCHEN. (Insecticides and metabolism. XII. Isolation and identification in rabbit urine of metabolites of aldrin-^{14}C.) Med. Pharmacol. exp. 15 (1966) 409-414. (In German, with English and French summaries)

After intravenous injection of ^{14}C-aldrin into male rabbits, the major part of the radioactivity is eliminated in the urine rather than the faeces. Column and thin-layer chromatography allowed eight metabolites to be isolated from the urine, some of which could be identified. Trans-6,7-aldrin-diol (metabolite VII), with 43%, is the main breakdown product. Two other metabolites, III and IV, derived from this diol by acylation, were also isolated. In addition to the trans form, a less hydrophilic aldrin-diol (VI) of unknown structure was isolated; it is not identical, however, with the cis-6, 7-aldrin-diol obtained from aldrin and KMnO. (Auth.)

649 Kroczyński, J., Drygas, M. WSTEPNE BADANIA NAD OZNACZANIEM POZOSTAŁOSCI DDT ZNACZONEGO WEGLEM AKTYWNYM. (Preliminary investigation on the determination of the residues of DDT labelled with C-14.) Poznan Inst. Ochron. Rost. Biul. 32 (1965) 57-64. (In Polish, with English summary)

Microplots of potatoes were used, and experiments carried out with ^{14}C-DDT. A single application of DDT (series I: 0.8932 g p,p'-DDT-^{14}C of specific activity 1.45 mCi/g giving a total activity of 1 mCi, mixed with 1.6068 g of unlabelled DDT and made up to 50 ml) gave 1.2 ppm of residue in the soil. A double application (series II: 0.4466 g p,p'-DDT-^{14}C of specific activity 1.45 mCi/g giving a total activity of 0.5 mCi when mixed with 4.5534 g of unlabelled DDT and made up to 50 ml) gave 2.0 ppm of residue in the soil. In two experimental series no residues of <0.026 ppm were found for series I, and none <0.07 for series II. Spraying took place 113 d before harvesting (single); 113 and 71 d before harvesting (double); and 71 d before harvesting (single). Single application of DDT (series I) gave 1.2 ppm of residue in the soil; a double application of DDT (series II) gave 2.0 ppm.

650 Kulikova, M.N., Strongin, G.M., Khokhlova, L.F. DETERMINATION OF THE γ-ISOMER IN HEXACHLORAN DUST BY THE METHOD OF ISOTOPIC DILUTION. Trudy Khim. Khim. Tekhnol. No.2 (1964) 288-292. (In Russian)

The method of isotopic dilution was developed for the determination of the content of γ-isomer in dusts on the basis of hexachloran. The γ-isomer was separated by extraction and precipitation; the melting temperature range was 113.2-114.0°C. The average absolute error of the method was 0.07%, the average relative error 5.3%. Examples for the application of the method, e.g. with talcum, are given. (CA 63: 1965, 8983e)

651 Lage, G.L., Oeth, D., Spratt, J.L. EFFECT OF CHLORDANE AND DDT PRETREATMENT ON THE METABOLISM OF DIGOXIN-^{3}H BY MONKEY HEART AND LIVER TISSUE IN VITRO. Archs int. Pharmacodyn. Thér. 169, 2 (1967) 255-281.

The in vitro hepatic metabolism of ^{3}H-labelled digoxin (I) was studied in the squirrel monkey. The effect of common insecticides on I metabolism was also studied. Chlordane and DDT were each injected intraperitoneally at 10 mg/kg daily for 7 d. A significant decrease in recoverable digoxigenin was observed upon incubation of tritiated I for 5 h under O with non-treated monkey liver slices. The only detectable effect of chlordane pretreatment was a 100 or 60% increase in the alcohol-soluble fraction for both the heart and liver slices, respectively. DDT did not affect the metabolism of I under the conditions studied. Control heart slices did not metabolise I. Control liver slices metabolised I to a lesser extent than did those previously reported for the rat. (CA 68: 1968, 2213z)

652 Lawler, P.D., Rogers, L.J. BIOCHEMICAL INVESTIGATIONS INTO THE EFFECT OF DDT ON BARLEY. Biochem. J. 103, 2 (1967) 44P. Also presented at "469th Meeting of the Biochemical Society. Proceedings. Dublin, 20-22 Mar. 1967".

Studies were confined to one susceptible (Rika) and one resistant (Proctor) variety of barley. Manometric studies of gas exchange in DDT-treated barleys were made. It appeared that DDT affected a photosynthetic process in the susceptible barley. Studies of distribution of radioactivity amongst the soluble products of photosynthesis showed no qualitative difference between sprayed and un-

sprayed susceptible and resistant varieties. However, the proportion of the leaf material extractable with ethanol from Rika seedlings 8 d after DDT treatment was increased ~ 40% compared to DDT-treated Proctor. On the evidence available it is suggested that in susceptible barley varieties DDT affects the light reaction in photosynthesis.

653 Laws, E.R., Jr. ROUTE OF ABSORPTION OF DDVP AFTER ORAL ADMINISTRATION TO RATS. Toxic. appl. Pharmac. 8, 2 (1966) 193-196.

Ten rats were infused by stomach tube with radioactive DDVP while timed samples of portal blood, systemic venous blood, and chyle were taken. Levels of DDVP were detected in all samples and were much higher in portal blood than in either systemic blood or chyle. They were slightly higher in systemic blood than in chyle. These findings support the hypothesis that, in the rat, DDVP taken orally is absorbed primarily if not exclusively by the hepatic portal venous system, and, therefore, is routed through the detoxification processes of the liver before reaching the systemic circulation. (CA 64: 1966, 13327h)

654 Ludwig, G. ISOLATION AND IDENTIFICATION OF METABOLITES OF SOME CHLORINATED INSECTICIDES, AND THEIR DETECTION BY ANALYTICAL METHODS. p.49-58 of "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, Austria, 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria). 1966, 118 p.

The general metabolism and detoxification mechanism operative in drin-insecticides proved to be dechlorination and hydroxylation. Metabolites of α-chlordane-^{14}C and dieldrin-^{14}C were isolated in crystalline form. Rabbits were given weekly doses of 100 mg of α-chlordane-^{14}C for 10 weeks by stomach tube; 2 weeks after the last dose they were sacrificed. 47.2% of the total administered activity was excreted in the urine, 22.7% in faeces, with only ~ 4% present in the fatty tissues. Hydrophilic metabolites were found in urine: metabolite A, with a toxicity <1/3 of that of chlordane and with a structure of 1-hydroxy-2-chloro-dihydrochlordane, and an even more hydrophilic metabolite B, where both Cl-atoms in positions 1 and 2 of α-chlordane-^{14}C may be replaced by hydroxylic groups. - In dieldrin tests, rabbits received 206 mg over 21 weeks, administered twice weekly: a total of 56-58 mg ^{14}C-dieldrin/kg body weight. At the end of the feeding period 42.2% of the radioactivity administered had been eliminated (29.7% in urine, 12.5% in faeces), increasing to 43.1% in urine after 52 weeks. A metabolite V was obtained as needle-like crystals. The epoxy ring system of dieldrin was concluded to be hydrolysed in vivo in the metabolite, leading to a 6,7-dihydroxydihydro-aldrin. The structural formula of metabolite V must correspond to one of the two enantiomorphic isomers of synthetical racemic trans-6,7-dihydroxydihydro-aldrin. Its acute oral toxicity to mammals was found to be ~ 1/2-1/16 of that of dieldrin. Two of the other metabolites (II and III) present in urine (~ 2-4%) were found to give the main metabolite by hydrolysis. Their probable structure is discussed. - After intravenous administration of telodrin-^{14}C lactone was isolated from the excreta of rats, explicable by the formation of the unstable acetate intermediate. Its acute toxicity for mammals was 30 times lower than of telodrin. - One of the sub-metabolites of dihydroheptachlor (in rat excreta) was chromatographically identical to synthetical 2-hydroxydihydro-chlordane.

655 MacRae, I.C., Raghu, K., Castro, T.F. PERSISTENCE AND BIODEGRADATION OF FOUR COMMON ISOMERS OF BENZENE HEXACHLORIDE IN SUBMERGED SOILS. J. agric. Fd Chem. 15, 5 (1967) 911-914.

The persistence of the γ isomer of benzene hexachloride (lindane), when added to submerged tropical soils at a rate approx. three times that recommended for the protection of rice from stem borer infestation and of the α, β, and δ isomers of benzene hexachloride applied at similar rates was between 70 and 90 d. Losses of all four isomers from sterilized, flooded soil samples were much slower than from non-sterilised samples, indicating that the microflora of submerged soils is able to degrade benzene hexachloride. Microbial degradation of γ-BHC was demonstrated by the release of $^{14}CO_2$ from submerged soils treated with ^{14}C-labelled γ-BHC. An application of γ-BHC at a rate approx. five times the usual field rate apparently inhibited CO_2 evolution from two tropical soils. (Auth.)

656 Matsumura, F., Hayashi, M. INTERACTION OF DIELDRIN WITH THE SUBCELLULAR COMPONENTS OF BOTH RESISTANT AND SUSCEPTIBLE STRAINS OF Aedes aegypti. Mosquito News 26, 2 (1966) 190-194.

Heads and (in some experiments) bodies of 4th-instar larvae of A. aegypti were homogenized in 0.25 M sucrose and incubated for 1 h at 24 °C with ^{14}C-labelled dieldrin (I). The material was separated by ultracentrifugation into crude nucleus, mitochondrial, microsomal, and supernatant fractions. With susceptible larvae, whole body crude nucleus absorbed more I than that of resistant larvae. Head crude nucleus absorbed only slightly more in vivo, resistant individuals picked up twice as much I as susceptible, but the distribution ratio of I between crude nucleus and other fractions is similar in the two cases. I evidently binds strongly with nerve compounds, but it does not appear that the in vivo I effect is related to the fundamental mechanism of resistance. (CA 65: 1966, 12805h)

657 Matsumura, F., Hayashi, M. DIELDRIN: INTERACTION WITH NERVE COMPONENTS OF COCKROACHES. Science, N.Y. 153 (1966) 757-759.

The amount of binding of ^{14}C-dieldrin and the effect of time on the rate of binding with the nerve components of susceptible and resistant Blattella germanica were investigated. There is evidence that the nerve components of the dieldrin-resistant cockroach have less binding capacity for dieldrin than those of the susceptible roach; the highest interstrain difference was in the crude-nucleus fraction. The dieldrin-nerve-complexes are not extracted by many organic solvents.

658 Matsumura, F., O'Brien, R.D. ABSORPTION AND BINDING OF DDT BY THE CENTRAL NERVOUS SYSTEM OF THE AMERICAN COCKROACH. J. agric. Fd Chem. 14, 1 (1966) 36-39.

The abdominal nerve cord of adult male Periplaneta americana, and ^{14}C-DDT (ethane-labelled) were used. It is hypothesised that DDT interferes with nervous function by forming a charge-transfer complex with a component of nerve. Studies on the kinetics and equilibria of DDT penetration into and out of nerve cords indicated the formation of complexes of DDT with two components of the cord and having dissociation constants of approx. 6×10^{-6} M and 1.5×10^{-7} M. At 10^{-5} M DDT, ~ 83% of the DDT in the cord is complexed. Two complexes have been partially purified on Sephadex and DEAE-cellulose columns. One contains protein and is extractable by butanol.

659 Matsumura, F., O'Brien, R.D. INTERACTIONS OF DDT WITH COMPONENTS OF AMERICAN COCKROACH NERVE. J. agric. Fd Chem. 14, 1 (1966) 39-43.

The nature and consequences of binding of DDT to components of the cockroach nerve cord were examined. ^{14}C-DDT (specific activity 4.93 mCi/mM) was added to the isolated nerve cord or injected into a living male cockroach with ethanol (final concentration of ethanol, 1%) followed by isolation of the nerve cord. When ion-transport through the nerve membrane was studied with radioactive cations, non-radioactive DDT was used instead. To study the effect of DDT in vivo, DDT was injected into a male roach and then, after 15 min, radioactive ions (either ^{42}K or ^{24}Na) were also injected. The radioactive salts used were ^{24}NaCl (100 mCi/g), ^{42}KCl (20 mCi/g), and $^{45}CaCl_2$ (500 mCi/g). - The butanol extract of a DDT-treated nerve homogenate showed a pronounced bathochromic shift in u.v. spectrum in comparison with DDT alone. The absorption spectrum of an unextracted DDT-treated homogenate showed a new shoulder at 240 to 270 mμ: the fluorescent spectrum on activation of 310 mμ showed a new peak at about 420 mμ. A complex, possibly of the charge-transfer type, was therefore suggested between DDT and a component of nerve. Nerve cords from DDT-treated cockroaches showed large increases in their ability to take up sodium or lose potassium, whereas ability to lose sodium or take up potassium was unchanged. The relation among complex formation, changes in ion permeability, and toxicity is not yet established.

660 Matsumura, F., Boush, G.M. DIELDRIN: DEGRADATION BY SOIL MICROORGANISMS. Science, N.Y. 156 (1967) 959-961.

An attempt was made to discover microorganisms that degrade dieldrin. Examination of >500 isolates from soil that had been heavily contaminated with various insecticides revealed the existence of a few microbes that are very active in degrading dieldrin to various metabolites (see table). Results of extraction and partitioning experiments on soils treated with ^{14}C-dieldrin indicated that ~ 1-6% of added dieldrin was converted to water-soluble metabolites by such soil samples.

661 Meeks, R.L., Peterle, T.J. THE CYCLING OF Cl-36 LABELLED DDT IN MARSH ECOSYSTEM. COO-1358-3, Ohio State Univ., Research Foundation, Columbus. Apr. 1967. 234 p. Thesis.

An enclosed 4-acre freshwater marsh was treated on 7 Jul. 1964 with 3.9 mCi of ^{36}Cl ring-labelled DDT at a rate of 0.2 lb of technical DDT/acre. Inert attapulgite granules carrying the DDT were applied by helicopter at 100 lb/acre. The project was designed to determine the accumulation and distribution of DDT rather than its effect. The labelled DDT residues were traced from 1 h until 15 months after application (~ 5000 environmental samples were assayed). Whole body residues were of major concern, although tissues were assayed from vertebrates that were too large to prepare as a unit. The results show that DDT is rapidly accumulated in the biotic environment. Residues were detected in sago pondweed, duckweed, bladderwort, crayfish, tadpoles, and carp when they were first assayed 4 h after DDT application; 3 d after the application Cladophora contained an average of 98 ppm, or 3125 times the environmental level. This was the highest accumulation recorded for any organism during the project. Fat contained the highest residues in most vertebrate tissues. A northern water snake accumulated 40 ppm 15 months after the application. The max. level in carp was 19 ppm in the soft palate. The skin and eyes of carp also contained relatively high residues. Plants and most invertebrates accumulated their highest residues during the 1st week while DDT could still be detected in the water. Vertebrates required longer periods of time. Tadpoles were an exception in that they immediately accumulated their highest DDT residues right after application. Examples of food-chain residues accumulation are noted. Plants re-accumulated low residues when they commenced growing the 2nd year. The DDT residues in plants, invertebrates, and small vertebrates remained fairly low throught the 2nd year; higher quantities often occurred in tissues from large vertebrates. Algae, the pondweeds (Potamogeton sp.), duckweed, crayfish, and small carp should make good indicator species of environmental DDT levels.

662 Meeks, R.L., II. THE CYCLING OF CHLORINE-36 RING-LABELLED DDT IN A MARSH ECOSYSTEM. Diss. Abstr. 27B, 9 (1967) 2947-8.

DDT [2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane] residues are widespread in the biosphere. This project was designed to provide information about the occurrence and translocation of these residues in aquatic environments. An enclosed 4-acre marsh located at the southwestern edge of Lake Erie was treated with 3.9 mCi of ^{36}Cl-ring-labelled DDT at a rate of 0.2 pounds/acre. The DDT was applied by helicopter on 100 pounds of inert attapugite granules/acre. Radiolabelled DDT residues were traced until 15 months after the application. Approx. 5000 environmental samples were assayed. Whole body residues were of major concern, although tissues were assayed from vertebrates too large to assay entire. Residues were detected in sago pondweed (Potamogeton pectinatus), lesser duckweed (Lemna minor), bladderwort (Utricularia vulgaris), crayfish (Orconectes immunis), tadpoles (Rana pipiens), and carp (Cyprinus carpio) when they were first assayed four hours after the DDT application. 3 d after the application, the algae Cladophora contained an average of 96 ppm, or 3125 times the environmental level. This was the highest accumulation recorded for any organism during the project. Fat contained the highest residues in most vertebrate tissues. A northern water snake (Natrix sipedon) accumulated 40 ppm 15 months after the application. The maximum level in carp was 19 ppm in the soft palate. The skin and eyes of carp also contained relatively high residues. Plants and most invertebrates accumulated their highest residues during the 1st week while DDT could still be detected in the water. Vertebrates required longer periods of time. Tadpoles were an exception in that they immediately accumulated their highest DDT residues right after the application. Examples of food-chain residue accumulation are noted. Plants re-accumulated low residues when they commenced growing the 2nd yr. The DDT residues in plants, invertebrates, and small vertebrates remained fairly low throughout the 2nd year; higher quantities often occurred in tissues from large vertebrates. Algae, the pondweeds (Potamogeton sp.), lesser duckweed, crayfish, and small carp should make good indicator species of environmental DDT levels. (From DA)

663 Mercer, W.A., Ed. APPLICATION OF RADIOCHEMISTRY TECHNIQUES IN FOOD PROCESSING RESEARCH. RADIOISOTOPIC TRACER TECHNIQUES IN EVALUATION AND IMPROVEMENT OF INDUSTRY PRACTICES FOR REMOVAL OF PESTICIDE RESIDUES FROM FOODS. Annual Report No.4, SAN-536-10, National Canners Association Research Foundation, Washington, D.C. 30 Nov. 1964, 48 p.

A standard soil was treated with a commercial DDT formulation which had been enriched with random ring-labelled DDT-^{14}C. Autoradiography of samples of the treated soil showed a satisfactory uniformity

of distribution of the pesticide. Periodic analyses of soil core samples indicated a slow downward migration of the pesticide. Extraction of the soil with dichloromethane gave a complete recovery of added DDT-^{14}C in treated soil samples. Red cored Chantenay carrots were grown in five-gallon containers filled with DDT-^{14}C treated soil. Autoradiography of 36-d-old seedlings showed a faint image in the root system. Evidence was obtained for a root-to-foliage and for a foliage-to-root migration of radioactivity. Carrots grown in soil treated with non-radioactive DDT had radioactivity in the root system. Foliage, sprayed with cold DDT, on carrots grown in DDT-^{14}C treated soil contained radioactivity. The major part of the carrot crop was harvested after 124 d of growth. The carrots were washed in a rotating reel washer using cold water sprays (75 lb/sq in. pressure) to remove dirt. An interesting distribution pattern was found for radioactivity in various parts of the washed carrots. Sixty-eight percent of the radioactivity was found in the rootlets, tap root end, and skin. These portions, which represent less than 7% of the carrot wt, are removed by food preparation operations. The level of DDT or its transformation products in the prepared carrot was less than 0.05 ppm. An extraction of the foliage cut from the harvested carrots was made to isolate possible transformation products from the DDT. The extract was purified by column chromatography and the eluate fractions analyzed by electron capture gas chromatography and thin layer adsorption chromatography. Autoradiography of a developed thin-layer plate demonstrated the presence of radioactive spots (in addition to the major component DDT-^{14}C) corresponding in R_f to 2,2-dichloro-1,1-bis(p-chlorophenyl)-ethene (DDE-^{14}C) and to 2,2-dichloro-1,1-bis(p-chlorophenyl)-ethane (TDE-^{14}C). The low level of radioactivity in peeled carrots made further studies on the reduction of pesticide residue content by blanching and preservation by dehydration, freezing, and canning of little practical significance. In a continuing program to improve pesticide residue analytical procedures, a method of separation and identification of chlorinated pesticides was developed. New methods for the clean-up and thin-layer chromatography of thiophosphate pesticides are described. The masking by crop extractives was reduced by using glycerine in the assy jars or by employing a more rigorous cleanup procedure. (Auth.)

664 Miyazaki, S., Boush, G.M. MICROBIAL DEGRADATION OF CHLOROPROPYLATE®(ISOPROPYL 4,4'-DICHLOROBENZILATE). Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 93, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

A soil fungus, Trichoderma viride and other microorganisms were found to degrade ^{14}C-labelled Chloropropylate® in a solution of yeast extract and mannitol. Thin-layer chromatography in conjunction with autoradiography was used to assess degradation and separate metabolites. (Abstr.)

665 Morgan, D.J., Duxbury, G. THE DETERMINATION OF CHLORINATED HYDROCARBONS IN THE ATMOSPHERE BY ACTIVATION ANALYSIS. Ann. occup. Hyg. 8 (1965) 253-256.

The method is applicable to chlorinated hydrocarbons generally, although the actual tests were carried out on degreasing agents such as trichlorethylene. The air sample containing about 10 mg of chlorinated hydrocarbon is drawn through a small charcoal pack by means of a battery-operated air sampler. The charcoal is then placed in a neutron flux and the ^{38}Cl formed is determined by γ-spectrometry. The results of an operational investigation are described.

666 Mumma, R.O., Wheeler, W.B., Frear, D.E.H., Hamilton, R.H. DIELDRIN: EXTRACTION OF ACCUMULATIONS BY ROOT UPTAKE. Science, N.Y. 152 (1966) 530-531.

Certain forage crops can absorb and translocate the chlorinated hydrocarbon insecticide dieldrin from soil or sand. An extraction technique routinely used for analyses of residues does not quantitatively remove this internal chemical, but a method employing chloroform-methanol extraction leads to essentially quantitative recovery. ^{36}Cl-dieldrin was used. After some trial and error it was found that almost 100% of the radioactivity could be extracted from labelled plants by (1) maceration and repeated blending of the plant material with n-hexane-isopropyl alcohol (2:1); and (2) 12-h reextraction of this tissue with a 1:1 mixture of chloroform and methanol in a Soxhlet extractor.

667 Oppenoorth, F.J. TWO TYPES OF SESAMEX-SUPPRESSIBLE RESISTANCE IN THE HOUSEFLY. Entomologia exp. appl. 10 (1967) 75-86.

In a resistant strain of house fly, Fc, derived from a Danish strain, DDT resistance and most of the diazinon resistance are under the control of the 3rd chromosome. Resistance to both compounds is suppressed by sesamex. These two facts indicate that there is a single mechanism responsible for

resistance to these (and many other) compounds. It appears that in this strain DDT is rapidly metabolised and that water soluble products are excreted. This metabolism is blocked by sesamex. A Dutch strain with high resistance to dithion did not show the low aliesterase activity characteristic of most organophosphate-resistant strains. Therefore a resistance mechanism different from that in most other strains was expected. The fact that sesamex can suppress the dithion resistance indicates that a detoxication-mechanism that can be blocked by this synergist is responsible for the resistance. The gene for this resistance is on the 5th chromosome. Ring-labelled ^{14}C-DDT was used. The radioactivity in excrements was determined.

668 Paul, B.B., Rubinstein, D. METABOLISM OF CARBON TETRACHLORIDE AND CHLOROFORM BY THE RAT. J. Pharmacol. exp. Ther. 141 (1963) 141-148.

18 h after intraduodenal administration of $^{14}CCl_4$, 85% had been excreted in the expired air unaltered and 1% had been converted to $^{14}CO_2$. After administration of $^{14}CHCl_3$, 70% had appeared in the expired air unchanged and 4% as $^{14}CO_2$. Liver slices also formed CO_2 more rapidly from $CHCl_3$ than from CCl_4. The metabolism of CCl_4 and $CHCl_3$ is greatly diminished if the tissues are homogenized. The production of CO_2 from chloromethanes by liver slices is stimulated by citrate and acetate, inhibited by iodoacetate, fluoride arsenate, cyanide and by acid, alkali or heat treatment of the liver slices. Succinate stimulated the metabolism only of CCl_4, not of $CHCl_3$. Neither reduced glutathione nor cysteine increases CO_2 production from CCl_4. Some CCl_4 is converted to $CHCl_3$ in vivo and in vitro. No evidence of the formation of other chloromethanes from either $CHCl_3$ or CCl_4 was obtained. It is concluded that CCl_4 and $CHCl_3$ are converted to CO_2 by enzyme-catalyzed reactions and that $CHCl_3$ probably is an intermediate in the metabolism of CCl_4. (Auth. summary)

669 Peakall, D.B. PESTICIDE-INDUCED ENZYME BREAKDOWN OF STEROIDS IN BIRDS. Nature, Lond. 216 (1967) 505-506.

The effects of low doses of DDT (10 ppm) and/or dieldrin (2 ppm) were tested on white 1-yr-old King pigeons weighing ~600 g, females being used for the progesterone and males for the testosterone experiments. Labelled compounds, progesterone-4-^{14}C and testosterone-4-^{14}C, were used. The experiments demonstrate that relatively small amounts of DDT and dieldrin can induce increased rates of metabolism of steroids by induction of hepatic enzymes. The effects of the two pesticides are additive but not synergistic.

670 Perry, A.S., Hennessey, D.J., Miles, J.W. COMPARATIVE TOXICITY AND METABOLISM OF p,p'-DDT AND VARIOUS SUBSTITUTED DDT-DERIVATIVES BY SUSCEPTIBLE AND RESISTANT HOUSE FLIES. J. econ. Ent. 60, 2 (1967) 568-573.

Comparative toxicity tests with DDT and o-Cl-substituted DDT-derivatives showed that o-Cl-DDT was the most toxic compound to DDT-resistant house flies, Musca domestica L. Steric hindrance caused by the o-chlorine atom reduces the enzymatic dehydrochlorination of the molecule and, correspondingly, restores its toxicity against the resistant strains. One strain, highly resistant to o-Cl-DDT, did not dehydrochlorinate the latter compound to a great extent, but the resistance mechanism is not known. Deuterated-DDT is only slightly more toxic than DDT to DDT-resistant house flies. At low dosages the latter can dehydrochlorinate deutero-DDT with equal facility as ordinary DDT, but at higher dosages an isotope effect on dehydrochlorination is evident. ^{3}H-DDT is considerably more refractory to alkali dehydrochlorination than p,p'-DDT which correlates favourably with enzymic breakdown of ^{3}H-DDT by homogenates of resistant M. domestica.

671 Ralls, J.W. USE OF RADIOISOTOPE TECHNIQUES TO DETECT AND MEASURE PESTICIDE RESIDUES IN AND ON FOODS AND TO EVALUATE COMMERCIAL FOOD PREPARATION PRACTICES. p. 28-29 of "Isotope Systems Development Program. 6th Annual Contractors Meeting, Washington, D.C., USA, 9-10 Nov. 1964", Feb. 1965, 73 p. N65-15844, Atomic Energy Commission, Washington, D.C. Div. of Isotopes Development.

A detailed study was carried out of the pickup, distribution, and removal of ^{14}C-DDT in and from carrots. A standard soil was treated with a commercial DDT formulation which had been treated with random ring-labelled DDT-^{14}C. Autoradiography of samples of treated soil showed a satisfactory uniformity of distribution of the pesticide. Periodic analysis of soil core samples indicated a slow downward migration of the insecticide. Extraction of the soil with dichloro-methane gave a complete recovery of added DDT-^{14}C treated soil. Red-cored chantenay carrots were grown in

five gallon containers filled with ^{14}C-DDT treated soil. Evidence was obtained for a root-to-foliage and for a foliage-to-root migration of radioactivity. DDE-^{14}C [2,2-dichloro-1,1-bis(p-chlorophenyl) ethene] and TDE-^{14}C [2,2-dichloro-1,1-bis(p-chlorophenyl)-ethane] were found in foliage in addition to DDT.

672 Romm, R.F. APPLICATION OF RADIOISOTOPES IN THE CONTROL OF CHEMICAL PROCESSES. AEC-tr-6466/1. p.297-309 of "The Uses of Radioactive Isotopes and Nuclear Radiation in the USSR. Proceedings of the All-Union Conference. Riga, USSR, 12-16 Apr. 1960". Vol.1. General Problems Connected with the Use of Isotopes. Devices Incorporating Radioactive Sources. Radiation Chemistry. Chemical and Oil Industries. 1961, 347 p. Translated from: "Radioaktivnye Izotopy i Yadernye Izlucheniya v Narodnom Khozyaĭstve SSSR, Trudy Vsesoyuznogo Soveshchaniya. Riga, USSR. 1960".

The use of radioisotopes in the control of chemical processes is discussed. The control of extraction columns using γ density gages, the measurement of solid-particle concentration in fluid-bed systems, the desiccation of chlorine, the automatic monitoring and control of an alcohol chlorination column in the production of DDT, an automated circuit for the chlorination of kerosene in the production of sulfonol, and the automatic control of crystallization processes are considered in some detail. (NSA 20: 1966, 23553)

673 Sanchez, E. DDT-INDUCED METABOLIC CHANGES IN RAT LIVER. Can. J. Biochem. 45, 12 (1967) 1809-1817.

Administration of DDT to rats resulted in an increase in the rate of incorporation of DL-leucine-1-^{14}C into proteins by a liver cell-free system. This effect was paralleled by an increase in the activity of microsomal DDT-metabolising enzymes and in total liver protein, as well as by increased synthesis of RNA. The level of total glutathione in liver and blood was not modified, but the amount of the oxidized form was increased at the expense of the reduced form. Phenobarbital or hydrocortisone also increased the levels of microsomal DDT-metabolising enzymes but their combination with DDT produced a relative inhibition. The role of DDT as an enzyme inducer and the possibility that changes in RNA correspond to increased synthesis of messenger RNA are discussed. (CA 68: 1968, 38478d)

674 Schaefer, C.H., Sun, Y.P. A STUDY OF DIELDRIN IN THE HOUSE FLY CENTRAL NERVOUS SYSTEM IN RELATION TO DIELDRIN RESISTANCE. J. econ. Ent. 60, 6 (1967) 1580-1583.

In general, there are no large differences in the rate of uptake of ^{14}C-dieldrin by the central nervous systems of susceptible or dieldrin-resistant female house flies, Musca domestica L., following injection or infusion. No evidence could be found that binding of dieldrin to tissues within the central nervous system is a significant factor in resistance. Metabolism of dieldrin within the same tissues was not detectable in either strain. Dieldrin resistance in house flies may be largely due to insensitivity at the receptor site. (Auth.)

675 Schoettger, R.A. THE TOXICOLOGY OF THIODAN IN SEVERAL FISH AND AQUATIC INVERTEBRATES. Diss. Abstr. 27, 12 Pt.1 (1967) 4609-B - 4610-B.

The objective of this investigation was to determine whether Thiodan, a chlorinated hydrocarbon, is suited chemically and toxicologically for use in fish control. The toxicity of Thiodan was tested against rainbow trout, fertilized eggs of rainbow trout, western white sucker, Daphnia magna and damselfly naiads. The median tolerance limits for trout and sucker ranged between 0.28 and 8.00 ppb and the fish were at least seven times more susceptible than the invertebrates. Toxicity was influenced by temperature, length of exposure and alkaline pH. Thiodan was not toxic to fertilized trout eggs. The deposition and metabolism of Thiodan in western white sucker, northern creek chub and goldfish was traced with the aid of ^{14}C-labelled Thiodan, and chemical analyses of Thiodan in tissues. Residues of the insecticide occurred in the skin and muscles of fish exposed to acute, and to multiple, sub-acute concentrations. Residues were poorly correlated with exposure. The mortalities of fish which were poisoned sub-acutely were correlated with their size and the lipid content of muscle. The relative amounts of residues in the various tissues seemed to be associated with the method of treatment. A water-soluble metabolite of Thiodan occurs in the bile of treated fish. It appears to be a glucosiduronic acid conjugate of Thiodan alcohol. A possible metabolic pathway for Thiodan degradation is discussed. Thiodan appears to have little value as a selective piscicide

against rough fishes such as carp or sucker, but under certain conditions, it may be a good, general fish toxicant. (DA)

676 Schuntner, C.A., Schnitzerling, H.J. SEPARATION OF DDT AND RELATED COMPOUNDS ON A SILICIC ACID COLUMN USING GRADIENT ELUTION. J. Chromat. 21 (1966) 483-485.

Metabolites of ^{14}C-labelled DDT extracted from the cattle tick Boophilus microplus (Canes.) were required in a high degree of purity for spectroscopic examination. Solvent-washed, activated silicic acid was used for all preliminary separation and subsequent clean-up of metabolites. A column chromatographic method was used. A clear separation of DDE, DDT, DDD, and DDA was obtained. Although Kelthane and DBP were not completely separated here they should be resolvable by continuing the benzene gradient instead of using pure benzene elution. In the original metabolite work o,p'-DDT was present as a minor impurity and separated satisfactorily, eluting ahead of the p,p'-DDT. Recoveries in the present experiment ranged from 95%-100% by gravimetry.

677 Stenersen, J.H.V. DDT-METABOLISM IN RESISTANT AND SUSCEPTIBLE STABLE-FLIES AND IN BACTERIA. Nature, Lond. 207, 4997 (1965) 660-661.

Regular exposure of Stomoxys calcitrans(L.)to DDT having resulted in the development of 30-fold resistance to DDT, 110-fold resistance to methoxy-DDT (methoxychlor) and extremely high resistance to DDD (TDE), mainly due to one gene allele [RAE-B 54: 1966, 11], experiments were carried out to investigate whether the resistance was caused by differing rates of absorption, metabolism or excretion of DDT. Resistant and susceptible flies were treated topically with 0.0164 μg radioactive DDT (labelled with ^{14}C) in acetone and kept at 25°C [77°F] in glass cages and supplied with fresh blood every day. Examination of samples of flies at intervals after treatment showed that there were no differences in the rates of absorption, detoxication or excretion of DDT by resistant and susceptible flies. Both metabolised only small amounts to DDE. When resistant flies were treated with 10 μg DDD extracts of them yielded only this compound. Excreta of the resistant flies treated with DDT were collected in the 24 h after the application and were found to contain DDT, DDE, DDD and a water-soluble metabolite. Three strains of bacteria, including Serratia marcescans and an unidentified strain, facultative anaerobes, were isolated from the excreta and, with laboratory strains of three other bacteria (including the facultative anaerobe Escherichia coli), were grown in a medium containing radioactive DDT in various conditions of aeration. The facultative anaerobes converted DDT almost completely to DDD and DDE when growing in a nitrogen atmosphere or in conditions of oxygen deficiency, but neither facultative anaerobes nor obligate aerobes converted any DDT when grown in aerated culture. It is concluded that the mechanism of resistance in S. calcitrans must be unusual; and the fact that bacteria from the intestines of the flies could convert DDT to two of the three metabolites found in the fly excreta further indicates that the cause of resistance to DDT, methoxy-DDT and DDD in this species is not detoxication by the fly. (RAE-A, 54: 1966, 110)

678 Street, J.C., Chadwick, R.W. STIMULATION OF DIELDRIN METABOLISM BY DDT. Toxic. appl. Pharmac. 11, 1 (1967) 68-71.

The excretion of polar metabolites of dieldrin by DDT-treated female rats greatly exceeded that by rats given only dieldrin-^{14}C. Increased metabolite excretion was observed in both faeces and urine, the relative increase being greater in the urinary products. The chromatographic properties of the major urinary dieldrin metabolite in DDT-stimulated rats did not match those of trans-dihydroxydihydroaldrin, the principal urinary metabolite in the rabbit. (CA 67: 1967, 81470)

679 Strongin, G.M., Kulikova, M.N. THE USE OF THE RADIOACTIVE ^{36}Cl ISOTOPE FOR CONTROLLING THE PRODUCTION AND PROCESSING OF HEXACHLOROCYCLOHEXANE. Atomn. Energ. 18, 1 (1965) 84-85.

The isomeric composition of hexachlorocyclohexane (I) was measured by isotopic dilution, using the individual isomers labelled with ^{36}Cl; the measurements showed that the wastes contain 10-15% of the γ-isomer, rather than 3% (as assumed before the measurements). As a result, it was decided to use the wastes as an insecticide. Isomers labelled with ^{36}Cl were also used to measure the solubility of I in various solvents. Because of the high cost of ^{36}Cl and in order to reduce the accumulation of radioactive wastes, the ^{36}Cl was recovered from the labelled isomers by conversion into $Na^{36}Cl$. (CA)

680 Sun, Y.P., Schaefer, C.H., Johnson, E.R. EFFECTS OF APPLICATION METHODS ON THE TOXICITY AND DISTRIBUTION OF DIELDRIN AND RESISTANCE IN HOUSE FLIES. Bull. ent. Soc. Am. 12 (1966) 248. Abstr. 25, at "Portland Meeting, Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

Toxicities by injection, infusion, and topical application and distribution of ^{14}C-labelled dieldrin in house flies indicate a possible resistance factor in house flies. (Abstr.)

681 Sun, Y.P., Schaefer, C.H., Johnson, E.R. EFFECTS OF APPLICATION METHODS ON THE TOXICITY AND DISTRIBUTION OF DIELDRIN IN HOUSE FLIES. J. econ. Ent. 60, 4 (1967) 1033-1037.

When dieldrin is infused into Musca domestica L. its toxicity is much less than when it is injected into them. Similar results were obtained for DDT but not for SD 11319 (3-hydroxy-cis-crotonamide dimethyl phosphate). It was suspected that during infusion a good part of the dieldrin and DDT was adsorbed onto proteins or partitioned into lipids and thus was not available for penetration to the site of action. However, because of the hydrophilic property of SD 11319, its activity was about the same by either injection or infusion. Analyses of ^{14}C-dieldrin in house flies following injection and infusion indicate the effects of adsorption and partition on the distribution of dieldrin. No large differences could be found. The rate of penetration and amount of ^{14}C-dieldrin in the haemolymph and in the central nervous system, following injection or infusion, do not provide the same magnitude of difference as for the toxicity results. (Auth.)

682 Troitskiĭ, I.A., Kartashova, V.M., Kartashov, P.A. RESORPTION, EXCRETION, AND RETENTION OF LABELLED DDT IN ANIMALS. p.481-488 of "Trudy Tashkentskoĭ konferentsii po mirnomu ispol'zovaniyu atomnoi energii". Vol.3. Tashkent, Akad. Nauk Uzb. SSR, 1961.

10 min after a solution of labelled DDT (I) was applied on the skin of rabbits, the radioactivity appeared in blood. It increased progressively during the next 3 h, after which a decrease was found. Even after 1 yr a slight radioactivity of the blood was noted. I appeared in urine already 10-15 min after application. Excretion of I in faeces and urine was highest during the 5th to 15th day of the experiment, while only traces of I were found during 2.5-12 months. No excretion of I occurs in the skin. 30 min after the application, I was found in lung, spleen, and kidney; 1.5-2 h after that highest amounts of I were present in spleen, bone marrow, and kidney, while after 4.5 h in the liver. After 2.5 months highest retention of I was found in fat tissue, bone marrow, kidney, and liver. These amounts gradually decreased and after 1 yr I was present only in kidneys. Similar results were obtained when cats, cows, young rabbits, or claves were used. No degradation of I is thought to occur in the animal organism, since no presence of radioactive CO_2 could be detected. (CA 56: 1962, 12825a)

683 Ullberg, S., Koransky, W. AUTORADIOGRAPHISCHE UNTERSUCHUNGEN AN SCHNITTEN DURCH GANZE TIERE ÜBER DIE VERTEILUNG MARKIERTER SUBSTANZEN. (Autoradiographic investigations on sections through the whole animal as to the distribution of labelled substances.) Nauyn-Schmiedebergs Arch. exp. Path. Pharmak. 246, 1 (1963) 65-68. (In German)

With the aid of the method of autoradiography of sections through whole animals, elaborated by Ullberg, the two narcotics glutethimide and thalidomide and the contact insecticide hexachlorocyclohexane were studied. The substances were labelled with ^{14}C. The examination was made at different times after administration to pregnant animals and to some male animals. The results are demonstrated on the basis of numerous autoradiograms. The radioactivity of glucose labelled in the 6 position is distributed at a great speed over nearly all the tissues of the mother animal and foetus. As early as after 1 min a considerable accumulation manifests itself in brain and liver of the mother animal. Other maternal organs in which gradually an accumulation takes place are retina and lens, Harder's gland, salivary and mammary glands, the gastric wall as well as intestinal and vaginal mucosa, adipose and cartilaginous tissues and myocardium, but not the skeletal musculature. In the foetus at the same time a relatively uniform distribution of the radioactivity over all organs is seen. After administration of ^{14}C-glutethimide, an accumulation of radioactivity manifests itself in the adipose tissue, brain and myocardium, in the walls of the large blood vessels and in the mammary glands of the mother animal. In the embryo nearly all the organs have the same ray density as the foetal blood. Also thalidomide is relatively rapidly transferred to the foetus and is distributed with surprising uniformity over nearly all the organs of the mother animal

and embryo. No accumulation was seen in the lipid-containing structures. In the case of hexachlorocyclohexane the radioactivity is concentrated in the organs which are rich in lipids, notably in the adipose tissue and brain. The substance shows a great accumulation in some structures of the CNS. Comparison with histological sections shows that the accumulation takes place in the medullated fibres. (Nuclear Medicine)

684 Viel, G., Hascoet, M., Dubroca, G. THE ELIMINATION OF PESTICIDE RESIDUES ON APRICOTS BY WASHING BEFORE CANNING. Phytiat.-Phytopharm. 15, 1 (1966) 41-48.

Several detergents were tried for the elimination of S on apricots. The effect of the washings was assessed by the use of ^{35}S. About 60 treated apricots were soaked in 10 ℓ H_2O or solution, brushed mechanically for 2 min, and rinsed for 30 sec by spraying. Half of the lot was analysed immediately, the other half was canned to study eventual corrosion control. The washing treatments consisted of (A) H_2O (control), (B) H_2O and 0.002% dodecylbenzenesulfonate, (C) H_2O and 0.0125% oxyethylenated oleocetyl alcohol (I) (D) H_2O and 0.05% oxyethylenated sucrose tallow acid esters (II) and (E) H_2O with a mixture of 0.03% I and 0.02% II. Unwashed apricots contained 120-30 mg S/kg. Compared to the control treatment, the S content was reduced by 5.1% by B, to 17% by C, to 18% by D, and to 14% by E. Treatment D was preferred, as the detergent was biodegradable. Treatment C was also tried on apricots treated with DDT or with carbaryl. A H_2O washing reduced DDT content by 18% and carbaryl by 75%, but C reduced DDT by 28.5% and carbaryl by 83.5%. (CA)

685 Vinson, S.B. THE PENETRATION, DISTRIBUTION, AND METABOLISM OF ^{14}C LABELLED DDT IN THE LARVAE OF THE TOBACCO BUDWORM Heliothis virescens. Diss. Abstr. 26, 9 (1966) 5611.

Studies were carried out from Jun. 1963-Jan. 1965 to determine penetration, distribution and metabolism of ^{14}C-labelled DDT in 3rd-instar larvae of resistant and susceptible strains of H. virescens (F.). In the 3rd-instar larvae resistance is due to several factors. In the South Delta resistant strain, which had an LD50 of 117.9 µg/larva, the internal level of DDT was 0.41 µg/larva. Resistance in this strain appeared to be due to reduced penetration and to efficient elimination of the toxicant. Degradation was not important. The Mississippi resistant strain was the most resistant strain studied; LD50 was 286.2 µg/larva. DDT rapidly penetrated the cuticle in this strain. The dose was efficiently eliminated. Metabolism, however, was an important factor reducing the internal DDT concentration to a comparable level of 0.65 µg/larva. The rate of penetration was similar in the three susceptible strains. In the Auburn strain, the most susceptible studied, the ability to eliminate the dose was less than all strains studied. In this strain some DDT was degraded by a pattern similar to the Mississippi resistant strain. Even though metabolism occurred the internal level of DDT reached 1.07 µg/larva, the highest level found in the strains studied. In the Florida susceptible strain, which had an intermediate LD50 of 15 µg/larva, the rate of elimination was also intermediate between the two resistant and the Auburn strain. DDT degradation was of little importance in reducing the level of DDT internally. The internal level of DDT was 0.9 µg/larva. In the South Delta susceptible strain, which had an LD50 similar to the Florida strain, the rate of elimination and tissue levels of DDT internally were similar to the Florida strain. Although DDT degradation occurred in this strain it did not occur in the internal fraction and was, therefore, ineffective in further reducing the internal concentration of DDT. The only environmental difference between the South Delta resistant and susceptible strains was with diet consumed. The different diets resulted in a difference in response to DDT, and it appeared to be due to a change in cuticle permeability to DDT. It was suggested that the level of resistance in this insect was correlated to its ability to maintain DDT at a non-toxic level. Decreased penetration, efficient elimination and degradation of DDT appeared to be the main factors involved. Two degradation products of DDT were found. DDE was the predominant product found internally while both DDE and DDA were present in the holding vial fraction. The 5th-instar larvae are tolerant to DDT. This tolerance appeared to be due to the decreased ability of DDT to penetrate the cuticle in both resistant and susceptible strains. (DA 26: 1966, 5611)

686 Vinson, S.B., Brazzel, J.R. THE PENETRATION AND METABOLISM OF ^{14}C-LABELLED DDT IN RESISTANT AND SUSCEPTIBLE TOBACCO BUDWORM LARVAE, Heliothis virescens (F.). J. econ. Ent. 59 (1966) 600-604.

The fate of ^{14}C-labelled DDT* applied topically to larvae of the tobacco budworm, H. virescens (F.), was determined in several DDT-resistant and susceptible strains. The DDT did not penetrate effectively the cuticle of the older 5th-instar larvae. The same phenomenon occurred in the 3rd-instar larvae of the South Delta resistant strain. In the other resistant strain the DDT penetrated effectively the cuticle but was degraded rapidly and eliminated. The resistant South Delta strain when fed a diet of cotton leaves was susceptible to a topically applied dose of DDT which readily penetrated the cuticle. This diet-altered strain resembled one of the susceptible strains in the rate of penetration and elimination of the dose as well as having similar LD50 for DDT. The other susceptible strain showed DDT breakdown but was ineffective in reducing the DDT content internally owing to the rapid DDT absorption in conjunction with slow excretion of the dose. In all strains where DDT breakdown occurred both DDE and DDA were found, with the DDA increasing in the excreted fraction.

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* ring-labelled ^{14}C-p, p'-DDT

687 Vinson, S.B. EFFECT OF SEVERAL NUTRIENTS ON DDT RESISTANCE IN TOBACCO BUDWORM. J. econ. Ent. 60, 2 (1967) 565-568.

Tobacco budworm, Heliothis virescens (F.), larvae were found to be more tolerant to DDT when reared on an artificial diet high in ascorbic acid content than when reared on the same diet low in ascorbic acid. An additional source of lipids in the diet was also found to increase the tolerance of the larvae to DDT. Other dietary components were found to influence tolerance of the larvae to DDT. ^{14}C-DDT was used in that part of the study concerned with penetration rates. Larvae were held for 120 h before the level of radioactivity penetrating the cuticle was determined.

688 Wheeler, W.B., Frear, D.E.H., Mumma, R.O., Hamilton, R.H., Cotner, R.C. QUANTITATIVE EXTRACTION OF ROOT-ABSORBED DIELDRIN FROM THE AERIAL PARTS OF FORAGE CROPS. J. agric. Fd Chem. 15, 2 (1967) 227-230.

A blending procedure widely used to extract insecticide residues from fresh plant materials is inefficient when applied to crops containing solely internal accumulations of dieldrin. The repeated blending of corn, alfalfa, orchard grass, and wheat in n-hexane-isopropyl alcohol (2 to 1, 8 to 10 ml/g) resulted in the extraction of only 50-90% of the total insecticide found. An additional extraction with chloroform-methanol (1: 1) in a Soxhlet apparatus completely removed dieldrin. Factors other than the actual processing technique may affect the efficiency of dieldrin extraction by blending when this chemical is present within plant tissues. The extraction of insecticides from plant materials, whether surface or internal residues, is often the weakest link in the entire analytical procedure. Only by the use of labelled compounds (1) (2) is it possible to determine the absolute efficiency of extraction procedures. (Auth.)

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(1) ^{14}C-dieldrin
(2) ^{36}Cl-dieldrin

689 Williams, V.A. DETERMINATION OF THE FASTNESS PROPERTIES OF DIELDRIN IN WOOL BY RADIOACTIVE TRACER TECHNIQUES. Text. Res. J. 35, 2 (1965) 124-128.

Radioactive tracer studies show no exhaustion of dieldrin on wool from white spirit solutions, but a surface layer of crystals is formed which is easily removed by non-swelling solvents or detergents. From aqueous emulsions, rapid absorption of dieldrin occurs, which is hardly removed by aqueous extractions, and organic solvents remove only a small amount even after repeated extractions, which amount could be considered as lying on the surface of the fibres. (CA)

690 Witt, J.M. THE METABOLISM OF ^{14}C-LABELLED DDT BY THE LARGE MILKWEED BUG, THE HOUSE FLY, AND THE AMERICAN COCKROACH. Diss. Abstr. 26, 12 (1966) 7020.

Metabolism of DDT was studied in three species of insects which represented three different mechanisms of detoxification:

1.	No metabolism	Oncopeltus fasciatus (Dallas)
2.	Reduction	Musca domestica L.
3.	Oxidation	Periplaneta americana (Linn.)

The large milkweed bug, O. fasciatus (Dallas), did not metabolise significant quantities of DDT. This insect stores absorbed DDT as unchanged DDT in its internal tissues, and excretes unchanged DDT in the faeces. Although some water-soluble or oxidized products of DDT metabolism were indicated, the amount present was so small that detection was difficult. The unchanged DDT persists in the tissues for a long period of time and this is consistent with the long persistence of the symptoms of DDT intoxication in the milkweed bug. The house fly, M. domestica L., rapidly dehydrochlorinated DDT to DDE. DDE is stored in the insect tissues and excreted without further change. The house fly excretes a definite quantity of water-soluble products, but these compounds were minor metabolic products and could not be identified. The house fly either succumbs to, or survives, a dose of DDT within 24 h, and this is consistent with the rapid metabolism of DDT into DDE by the fly. The American cockroach, P. americana (Linn.), stores unchanged DDT and slowly metabolises the stored DDT into oxidation products. DDE is produced, but oxidized metabolites represent the primary excretion products. Seven products were detected in the faeces of the cockroach. Unchanged DDT and the commonly produced DDE represented two of these. One of the oxidized products was identified as DBP (p,p'-dichloro-benzophenone), and it was suggested that one of the other metabolites was DBH (p,p'-dichlorobenzhydrol). Unchanged DDT persists in the cockroach for a longer time than in the house fly, but not for as long a time as in the milkweed bug. This intermediate degree of persistence of DDT corresponds to the length of time the cockroach is subject to symptoms from an exposure to DDT. (DA)

691 Yaron, B., Swoboda, A.R., Thomas, G.W. ALDRIN ADSORPTION BY SOILS AND CLAYS. J. agric. Fd Chem. 15, 4 (1967) 671-675.

For most experiments, ^{14}C-aldrin (specific activity 56.7 μCi/mg) was used. The adsorption-desorption of aldrin as it initially comes in contact with soils, clays, and sand was studied in column and batch experiments. The aldrin was dissolved in a dilute aqueous electrolyte solution to simulate the conditions encountered in the field. The nature of clay minerals did not influence the amount of aldrin adsorbed. The amount of aldrin adsorbed by soils was found to be dependent on mechanical composition and organic matter content.

692 Yule, W.N., Chiba, M., Morley, H.V. FATE OF INSECTICIDE RESIDUES. DECOMPOSITION OF LINDANE IN SOIL. J. agric. Fd Chem. 15, 6 (1967) 1000-1004.

A mixture of soils was fortified with DDT, dieldrin, lindane, and heptachlor and was analysed monthly for qualitative changes. Only lindane decomposed during six months' exposure in percolated and standing moist soil. The breakdown product was analysed and identified chromatographically as γ-pentachlorocyclohexene, which was found by insect bioassay to be of the order of 1000 times less toxic than the parent lindane. The dehydrochlorination of lindane was 2-3 times greater in moist, acidic-to-neutral soil than in dry soil, and there was some experimental evidence that soil microorganisms were associated with the breakdown. However, specific in vitro microbial tests were inconclusive on this point. Bacillus cereus (also B. cereus variety mycoides), and a so-far unknown species of Bacillus were identified. When these specific bacterial cultures were fortified at 4 ppm with ^{14}C-labelled lindane, no evidence of a radioactive metabolite in the R_f position of γ-pentachlorocyclohexene was found by autoradiography of a thin-layer chromatography plate.

See also:

104 Effect of DDT on incorporation of ^{14}C-labelled glucose into protein and soluble intermediates of nymphal Triatoma infestans. (Villar, E. del. et al., 1967)

110 Enhanced protein synthesis in Triatoma infestans treated with DDT. (Agosin, M. et al., 1965)

111 The effect of DDT on the incorporation of glucose and glycine into various intermediates in DDT-resistant strains of Musca domestica L. (Agosin, M. et al., 1966)

112 The induction of NAD kinase by DDT in Triatoma infestans. (Agosin, M. et al., 1967)

138 Unique effects of DDT and other chlorinated hydrocarbons on the metabolism of formate and proline in the housefly. (Cline, R.E. et al., 1963)

163 Glutathione turnover in Triatoma infestans treated with 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane. (Hlivicky, J. et al., 1967)

585 Biochemistry of insecticide resistance in mosquitoes. (Perry, A.S., 1966)

586 The use of isotopes to study pesticide translocation in natural environments. (Peterle, T.J., 1966)

1717 Utilization of various radioisotopic devices and methods in the oil and chemical industries. (Dzhagatspanyan, R.V. et al.)

1729 Development of double isotope derivative assays for measurement of pesticide residues. (Bogner, R.L., 1965)

1731 Analysis of foods by neutron-activation techniques. (Buchanan, J.D. et al., 1963)

1737 Development of double isotope derivative dilution analyses for selected food additives. Final Report. (Bogner, R.L. et al., 1963)

1757 Radioactive nuclides in pesticide chemistry. II. (Dedek, W., 1967)

1.5.4. Organophosphorus Insecticides

693 Ågren, G., Ramachandran, B.V. THE EFFECT OF PYRIDINIUM ALDOXIMES AND ATROPINE ON THE INCORPORATION OF $DF^{32}P$ IN RAT LIVER FRACTIONS. Acta physiol. scand. 60 (1964) 95.

The incorporation of radioactive diisoprophyl phosphorofluoridate ($DF^{32}P$) in the subcellular fractions of rat liver cells has been studied when injected alone or followed or preceded by pyridine-2-aldoxime methane sulphonate (P2S), N,N'-trimethylene-bis-(pyridinium-4-aldoxime) (TMB-4) and atropine. In experiments with only $DF^{32}P$ the total labelled phosphorus (^{32}P) incorporated in the liver as well as the amounts taken up in the microsomal and mitochondrial fractions attain a max. value in 20 min, but there is a considerable readjustment of ^{32}P between the nuclear and supernatant fractions even at 60 min. The oximes administered prophylactically or therapeutically affect both the rate of uptake of $DF^{32}P$ and the quantity incorporated. The effects are explained on the basis of the rate of penetration of $DF^{32}P$ in the cell and possible direct action of the oximes. Atropine has a high retarding effect on the uptake of $DF^{32}P$ in the liver, the total quantity incorporated being reduced to 5-10% of the control in some experiments. (Auth.)

694 Akintonwa, D.A.A., Hutson, D.H. METABOLISM OF 2-CHLORO-1-(2,4,5-TRICHLOROPHENYL) VINYL DIMETHYL PHOSPHATE IN THE DOG AND RAT. J. agric. Fd Chem. 15, 4 (1967) 632-637.

A single oral dose of 2-chloro-1-(2,4,5-trichlorophenyl)- [^{14}C]vinyl dimethyl phosphate to rats is almost completely eliminated in 4 d. 78% of the ^{14}C is excreted in the urine, 16.5% in the faeces, and 0.5% in the expired gases; 0.8% of the ^{14}C is present in the gut and contents after 4 d. After oral administration of the compound to dogs, 92% of the ^{14}C is excreted in the urine and faeces during 4 d. The compound is completely metabolized in dogs and rats: unchanged insecticide is absent from the urine. The metabolic products in the urine of rats and dogs were as follows (% of total dose in rat and dog, respectively, given in parentheses): 2,4,5-trichlorophenylethanediol glucuronide (8, 12%), [1-(2,4,5-trichlorophenyl)ethyl- β-D-glucopyranosid]uronic acid (35, 0%), 2,4,5-trichloromandelic acid (24, 12%), 2-chloro-1-(2,4,5-trichlorophenyl)vinyl methyl hydrogen phosphate (4, 46%), 2,4,5-trichlorophenylethanediol (2.5, 4%), and 1-(2,4,5-trichlorophenyl)ethanol (2, 0%). (Auth.)

OMISSION. Reference should here be made to 904, erroneously listed in the wrong context.

904 Albanus, L., Heilbronn, E., Sundwall, A. ANTIDOTE EFFECT OF SODIUM FLUORIDE IN ORGANOPHOSPHORUS ANTICHOLINESTERASE POISONING. Biochem. Pharmac. 14, 9 (1965) 1375-1381.

695 Awad, T.M., Vinson, S.B., Brazzel, J.R. EFFECT OF ENVIRONMENTAL AND BIOLOGICAL FACTORS ON PERSISTENCE OF MALATHION APPLIED AS ULTRA-LOW-VOLUME OR EMULSIFIABLE CONCENTRATE TO COTTON PLANTS. J. agric. Fd Chem. 15, 6 (1967) 1009-1013.

A comparison of the persistence of malathion applied to cotton leaves as a water-diluted emulsifiable concentrate or as an ultra-low-volume formulation showed that the ULV persisted longer than the emulsifiable concentrate with a half-life value of 4.6 and 2 d, respectively. Studies with glass

surfaces indicated that faster evaporation of the EC was, in part, responsible for the differential in persistence of the two formulations, particularly at 50°C. The EC formulation penetrated the leaf surface faster and a greater percentage of malathion was found in the internal fraction of the leaf compared with the ULV formulation. Results obtained by using ^{14}C malathion (labelled at the 2 and 3 position of the succinic acid moiety specific activity 2.87 mCi/mM) confirmed what was first found with the use of the colourimetric method, that the water-diluted ^{14}C-malathion EC disappeared at a faster rate than the technical ^{14}C-malathion. After 12 d from application, there was only 0.87% of the initial radioactivity on the surface of leaves which received ^{14}C-malathion EC, while after the same period of time radioactivity counts revealed that 21.8% of the initial radioactive malathion was still on the surface of those plants treated with ULV technical ^{14}C-malathion. Half-life values were 3.8 and 1.2 d for ULV and ^{14}C-malathion EC, respectively. Metabolism on the leaf surface did not appear to contribute to the difference in the persistence of both formulations, although a small amount of the monocarboxylic acid of malathion was found on the surface of plants treated with both formulations. In the internal fraction, the dicarboxylic acid metabolite of malathion was the major decomposition product.

696 Bazzi, B. DETERMINATION OF ROGOR AND CIDIAL BY THE ISOTOPE DILUTION METHOD. p. 27-32 of "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, Austria, 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna(Austria). 1966, 118p.

Preliminary results of an isotopic dilution method applied to the determination of residues of (^{32}P)-Rogor and -Cidial in olive oil and apples, respectively, are discussed. The equation used was

$$P_2 = P_1 \left(\frac{s_1}{s_2} - 1 \right)$$

where P_2 =unknown quantity of substance in the sample
P_1 =known quantity of labelled substance added to the sample
s_1=known specific activity of labelled substance added to the sample
s_2=measured specific activity of total substance in the sample after dilution.

To determine residues of Rogor (dimethoate) a benzene solution was used, the sample containing 19.5 µg/ml of ^{32} P-Rogor (specific activity 175.2 cpm/µg of compound). The methods used are described, involving a microcolorimetric P determination, following the destruction of organic substance. For Cidial in apples, a chloroform solution containing 25.14 µg/ml of ^{32} P-Cidial (specific activity 169.1 cpm/µg of compound) was used, the active substance again being determined via a colorimetric method for assessing P contents.

697 Beynon, K.I., Wright, A.N. THE BREAKDOWN OF ^{14}C-CHLORFENVINPHOS IN SOILS AND IN CROPS GROWN IN THE SOIL. J. Sci. Fd Agric. 18, 4 (1967) 143-150.

A sample of chlorfenvinphos (Shell Registered Trade Mark: Birlane) (2-chloro-1-(2',4'-dichlorophenyl) vinyl diethyl phosphate) was used, with a specific activity of 2.86 nCi/µg, labelled in the two vinyl carbon atoms. Soils of four different types were treated with a relatively high dosage level (15 ppm) of ^{14}C-chlorfenvinphos and were stored at about 22° C for four months. After this time the following radio-labelled compounds were detected in the moist soils: unchanged chlorfenvinphos, 1.0-4.7 ppm; 1-(2',4'-dichlorophenyl)ethan-1-ol, 0.06-1.0 ppm; 2,4-dichloroacetophenone, 0.1-0.5 ppm; desethyl chlorfenvinphos, 0.1-0.2 ppm; (2',4'-dichlorophenyl)ethan-1,2-diol, <0.03 ppm; salts or conjugates of desethyl chlorfenvinphos, 0.05-0.6 ppm; 2,4-dichlorophenyloxirane, < 0.005 ppm; 2,4-dichlorophenacyl chloride, <0.005 ppm. Soils were also treated with 3-4 lb/acre ^{14}C-chlorfenvinphos and cabbages, onions, and carrots were grown to maturity in the soils. The edible part of cabbages at harvest contained no detectable chlorfenvinphos or breakdown products of it when the limit of detectability was about 0.005 ppm. At harvest at 8-10 weeks after soil application of chlorfenvinphos the edible roots of carrots contained 0.12 ppm of unchanged chlorfenvinphos, and onion bulbs contained 0.07 ppm. There was evidence of trace amounts of a compound, probably a salt or conjugate of desethyl chlorfenvinphos, in onions (< 0.01 ppm) and in carrots (≤ 0.024 ppm). Carrots also contained traces (about 0.005 ppm) of 2,4-dichloroacetophenone.

698 Boyer, A.C. VINYL PHOSPHATE INSECTICIDE SORPTION TO PROTEINS AND ITS EFFECT ON CHOLINESTERASE I_{50} VALUES. J. agric. Fd Chem. 15, 2 (1967) 282-286.

The S-isomers of 1,2-^{14}C-SD 8447 and SD 7859 were prepared with specific activities of 0.9 and 1.0 mCi/mM, respectively. ^{14}C-Methoxy-labelled SD 3562 (crotonamide, N,N-dimethyl-3-hydroxy-cis-, dimethyl phosphate), SD 9129 (crotonamide, N-methyl-3-hydroxy-cis-, dimethyl phosphate), and SD 8447 insecticides were prepared with specific activities of 1.2, 0.2, and 1.0 mCi/mM. The two vinyl phosphate insecticides, 2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate (SD 8447) and 2-chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate (SD 7859), are sorbed to mammalian blood plasma and homogenates of house fly (Musca domestica) heads. The I_{50} values for the inhibition of the cholinesterase present in these preparations were determined for both compounds. The sorption data were used to correct the observed I values. The corrected I_{50} values represent the concentration of compound available for 50% inhibition of the enzyme, rather than the actual concentration of the inhibitor.

699 Bull, D.L., Lindquist, D.A. A COMPARATIVE STUDY OF INSECTICIDE METABOLISM IN PHOTOPERIOD-ENTRAINED AND UNENTRAINED BOLLWORM LARVAE Heliothis zea (Boddie). Comp. Biochem. Physiol. 16, 3 (1965) 321-325.

The metabolism of disulfoton (Di-Syston) labelled with ^{32}P in fifth-instar larvae of Heliothis zea (Boddie) from unentrained and light-synchronised populations was compared by the use of radiometric procedures. Larvae were treated by injection at consecutive 2-h intervals for 24 h and then analysed to determine the concentrations of hydrolytic and oxidative metabolites of disulfoton that were formed in 4 h. Differences in metabolite concentrations in unentrained larvae were not significant; however, in entrained larvae, variations were significantly different and followed a cyclic pattern. Maxima of hydrolysis product concentrations occurred at 24-h intervals in internal extracts and at 12-h intervals in excreta. Peak concentrations of oxidation products occurred at 12-h intervals in internal extracts but did not follow a definite pattern in excreta. (From auth.)

700 Bull, D.L., Lindquist, D.A. METABOLISM OF 3-HYDROXY-N-METHYL- CIS-CROTONAMIDE DIMETHYL PHOSPHATE (AZODRIN) BY INSECTS AND RATS. J. agric. Fd Chem. 14, 2 (1966) 105-109.

Different batches of radioactive Azodrin were used: Azodrin-O-methyl-^{14}C, Azodrin-N-methyl-^{14}C, and Azodrin-^{32}P. Insect species (insecticide-susceptible) used included adult boll weevils (Anthonomus grandis Boh.), females of adult Musca domestica L., adult Periplaneta americana L., and 5th-instar larvae of bollworm (Heliothis zea (Boddie)) and tobacco budworm (Heliothis virescens (F.)). Azodrin was administered orally to lepidopterous larvae. Male white rats (Wistar strain) were treated intraperitoneally. Various procedures were used to identify metabolites. Oxidative conversion of Azodrin to its N-methylol derivative occurred in the insects and rats. However, formation of the toxic unsubstituted amide derivative of Azodrin by complete oxidative N-demethylation apparently was a minor reaction. Similar metabolites of Azodrin were formed in the different test animals, but at widely different rates. Results are tabulated.

701 Bull, D.L. ABSORPTION AND METABOLISM OF TRICHLORFON BY INSECTS. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 43, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

A comparison was made of the absorption and metabolism of ^{32}P-labelled trichlorfon by several different species of insects. Factors influencing differences in susceptibility among species will be discussed. (Abstr.)

702 Bull, D.L., Lindquist, D.A., Grabbe, R.R. COMPARATIVE FATE OF THE GEOMETRIC ISOMERS OF PHOSPHAMIDON IN PLANTS AND ANIMALS. J. econ. Ent. 60, 2 (1967) 332-341.

The fates of the cis and trans isomers of phosphamidon in plants and animals were determined by using radiometric and other procedures. Phosphamidon was labelled either with ^{14}C at the methylvinyl and carbonyl positions or with ^{32}P. Cotton plants were tested extensively. Insects used included 5-to 7-d-old adult boll weevils, Anthonomus grandis Boh., Musca domestica L., 5th-instar tobacco budworms, Heliothis virescens (F.), and boll worms, Heliothis zea (Boddie). The biological half-lives of toxic forms of the 2 isomers were very short in plants and animals and of comparable duration. Although both isomers were converted to similar oxidative and hydrolytic metabolites, the rates of formation were somewhat different: the faster rate of oxidative N-dealkylation of cis phosphamidon in all biological systems was particularly apparent. Not only were the trans isomers of phosphamidon

and its N-deethyl derivative substantially more toxic to adult boll weevils Anthonomus grandis Boheman, and horse flies, Musca domestica L., than were the cis isomers, but they also were significantly more potent inhibitors of acetylcholinesterase in the insects. Combinations of sesamex with cis and trans phosphamidon and N-deethyl derivatives caused a substantial increase in the toxicity of all compounds to boll weevils, particularly the cis isomers.

703 Calderbank, A. A MENAZON FELFEDEZESE, SAJTSAGAI ES ANYAGGCSEREJE. (Discovery, properties and metabolism of menazon.) p. 1-13 of paper 85, presented at the "Pflanzenschutzkonferenz, Budapest, Hungary, Feb. 1966". (In Hungarian, with English summary)

A new class of heterocyclic thiophosphate esters, which combine outstanding aphicidal properties with low toxicity to other insect species and to mammals is reported. The compounds are characterized by a diamino-S-triazinyl-methyl group and one of the most active members is S-(4,6-diamine-1,3,5-triazin-2-ylmethyl) O,O-dimethyl phosphorodithioate (I), now known as menazon. It is a colourless crystalline solid, slightly soluble in water and in common organic solvents and forms salts with acids. Menazon and its salts possess very high contact, residual and systemic toxicity to aphid species but relatively little against most other insect groups. It is nonphytotoxic at well above normal dosage rates. Only slight cholinesterase inhibition is shown in vitro, and mammalian toxicity is very low. Menazon is readily absorbed by roots, and translocated throughout the plant in the xylem. Uptake through leaves is poor and movement is again associated with the transpiration stream (largely upwards and outwards). There is an absence of selective translocation to growing points. Six metabolites have been detected in plants treated with either ^{14}C- or ^{32}P-labelled menazon and three (II, III and IV) identified. One of these, the thiolate (II), is present in only small amounts and does not accumulate in plants. It is also formed as a major metabolite of menazon in the rat and, although a better cholinesterase inhibitor than menazon, has still a low order of toxicity. The identification of a major metabolite, 2,4-diamino-6-hydroxymethyl-s-triazine (III) in plants and the demonstration that two of the remaining unidentified metabolites are acidic proves that detoxification by hydrolysis occurs. $^{14}CO_2$ is also evolved in small amounts from plants treated with ^{14}C-triazine ring-labelled aphicide, showing that ultimately degradation of the triazine ring occurs.

704 Clemons, G.P., Menzer, R.E. OXIDATIVE METABOLISM OF PHOSPHAMIDON IN ANIMALS. Bull. ent. Soc. Am. 13, 3 (1967) 191. Abstr. 81. "New York Meeting of the Entomological Society of America. New York, N.Y., 27-30 Nov. 1967".

Radiolabelled phosphamidon was metabolized in goats and rats to yield 9 organosoluble metabolites. Both dechlorination and N-dealkylation occurred. The identification of five of the metabolites and data on the remaining unknown metabolites is reported. (Abstr.)

705 Coleby, A.W.P. EFFECTS OF PHOTOPERIOD, TEMPERATURE, AND HUMIDITY ON THE UPTAKE, TRANSLOCATION AND METABOLISM OF A SYSTEMIC PHOSPHONATE INSECTICIDE. Diss. Abstr. 28, 1 (1967) 2-B.

The part played by the physical environmental conditions on the uptake, translocation and degradation of the ^{32}P-labelled systemic phosphonate, O-methyl O-p-methylthiophenyl methyl-phosphonothionate on cotton plants were investigated. Plant growth cabinets were programmed to give each of the following sets of conditions: (a) high humidity, 14-h photoperiod, 65°F; (b) high humidity, 14-h photoperiod, 80°F; (c) low humidity, 14-h photoperiod, 65°F; (d) low humidity, 14-h photoperiod, 80°F; (e) low humidity, 14-h photoperiod, 94°F; (f) low humidity, 10-h photoperiod, 80°F; (g) low humidity, continuous light, 80°F; (h) low humidity, continuous light, 94°F. The uptake, translocation degradation was measured using radiochemical and bioassay techniques. An increase in the length of the photoperiod from 10-14 h increased plant growth, rate and amount of total radioactivity taken up and translocated by the cotton plants and improved insecticidal action of the systemic, although the rate of degradation was also increased. A further increase in photoperiod to 24-h (continuous light) reversed the above trends, although, at 80°F continuous light gave slightly greater uptake and higher amounts of chloroform soluble fraction and aphid mortality than the 10 h photoperiod. There is therefore a point at which an increase in photoperiod does not increase uptake and translocation of a systemic because too long a photoperiod upsets the plant's physiological functions. High humidity slowed both the rate of uptake and translocation of the systemic and the growth of the cotton plants. High humidity also, in some way, reduced the chloroform soluble fraction a markedly at the 24-h sample. At the 3-d sample the chloroform soluble fration had increased to

approx. the same percentage of radioactivity as was found in the low humidity experiments, i.e., 17% and 30% higher than the one day sample at 65°F and 80°F respectively. High humidity slowed the rate of degradation of the chloroform soluble fraction, the difference being greater between high and low humidity at 65°F than at 80°F. For both humidities the rate of degradation was much slower at 65°F than at 80°F. Increase in temperature increased plant growth, increased the uptake and translocation of systemic and increased the rate of degradation. (DA)

706 Dedek, W., Schwarz, H. ZUM VERHALTEN VON ^{32}P-MARKIERTEN INSEKTIZIDEN ORGANOPHOSPHORVERBINDUNGEN NACH INTRAZISTERNALER APPLIKATION BEIM RIND - EIN BEITRAG ZUR RESORPTION BIOLOGISCH AKTIVER SUBSTANZEN AUS DEM EUTER DES RINDES. (The behaviour of ^{32}P-labelled insecticidal organophosphorus compounds, following intracisternal application to cattle. A contribution to the resorption of biologically active substances from the udder.) Arch. exp. VetMed. 21, 6 (1967) 1505-1510. (In German, with English and Russian summaries)

250 mg of each labelled compound (trichlorfon, butonate, DDVP, and dimethoate) were administered to lactating cattle. The rate of resorption of systemic organophosphorus compounds from the udder proved approximately proportional to their water solubility. The concentrations of active substance in the blood and milk of the untreated quarters of the udder become approx. equal within 1 h already because of their relatively high resorption rate. Rapid enzymatic decomposition also takes place in the lacteal gland.

707 Dedek, W., Lohs, K. DIE DURCHLÄSSIGKEIT VON SCHUTZBEKLEIDUNGSMATERIALIEN FÜR INSEKTIZIDE PHOSPHORSÄUREDERIVATE (I). [The permeability of protective clothing materials to insecticidal phosphoric acid derivatives (I).] Chem. Tech., Berl. 17 (1965) 624-625. (In German)

^{32}P-labelled Tinox (a thiol isomer) and DDVP (O,O-dimethyl-dichlorovinylphosphate) were used to test various materials used for making up protective clothing used in working with toxic pesticides. PVC proved particularly efficient as protective material.

708 Dedek, W. BEITRÄGE ZUR ANALYTIK SYSTEMISCHER INSEKTIZIDER PHOSPHORSÄUREESTER IN BIOLOGISCHEN MEDIEN MIT HILFE ^{32}P-MARKIERTER VERBINDUNGEN. (On the analysis of systemic insecticidal phosphoric acid esters in biological media by means of ^{32}P-labelled compounds.) Thesis. Karl-Marx-Univ. Mathematisch-Naturwissenschaftliche Fakultät, Leipzig (East Germany). 1966, 158p. (In German)

The use of ^{32}P is discussed in studying the mechanism of insecticidal action, the metabolism and residues of an insecticide in different systems, and different forms of application. Special attention has been paid to the systemic Systox homologue Tinox: thiono- and thiol-Tinox were traced in vitro and in vivo. - The bulk of the work reported concerns suitable methods for dealing with endoparasites in veterinary medicine. Trichlorfon was used against warble fly (Hypoderma) larvae. The enzymatic degradation of trichlorfon in serum was studied extensively by thin-layer chromatography, also the rate of breakdown in vivo. Bubulin, a combination product, was used on cattle and pigs against Hypoderma. Metabolites were analysed for identity and toxicity. Dorsal pour-on application proved the most economical and efficacious method, and radioisotopes helped to determine the minimum concentration which would ensure safety with regard to, e.g., toxic products in milk. A further improvement was obtained from tracing the percutaneous resorption of tribuphon, and monitoring the concentration of active substance in the milk and of its more suitable metabolites. Tribuphon in milk fat is rapidly broken down into non-toxic products by milk sterilization.

709 Dedek, W., Schwary, H. EXCRETION OF ^{32}P-LABELED TRICHLORFON AND ITS DEGRADATION PRODUCTS IN THE MILK OF COWS AFTER VARIOUS ROUTES OF ADMINISTRATION. Arch. exp. VetMed. 20, 4 (1966) 849-857. (In German)

^{32}P-labelled trichlorfon applied to lactating cows, by dipping or by i.v. or i.m. injection, is excreted nearly quantitatively in the aqueous phase of the milk. Variations in the toxicity of the milk may be estimated by measuring the degradation of trichlorfon during pasteurization at 85°C. The degradation products are DDVP, dimethyl phosphate, and demethyltrichlorfon. (CA 66: 1967, 75228b)

710 Dedek, W., Scharz, H. STUDIEN ZUM METABOLISMUS UND ZUR APPLIKATION VON TRICHLORPHON IN DER VETERINÄRMEDIZIN. (Studies on the metabolism and application of trichlorfon in veterinary medicine.) Atompraxis 12, 12 (1966) 603-606. (In German)

Review, citing numerous studies in which radioisotopes had been used.

711 Dedek, W., Kisro, J. DER ABBAU DER TINOX-ISOMERE IN DER TOMATENPFLANZE. (The metabolism of tinox isomers in the tomato plant.) Atompraxis 12, 2 (1966) 100-104. (In German)

By means of ^{32}P-labelled compounds of high specific activity, the metabolism of the systoxhomologous systemic pesticide tinox was studied in tomato plants. The metabolites formed from thiono and thiol isomers were separated by extraction and identified by thin-layer chromatography and autoradiography. (Auth.)

712 Dedek, W., Lohs, K. DIE DURCHLÄSSIGKEIT VON SCHUTZBEKLEIDUNGSMATERIALIEN FÜR INSEKTIZIDE PHOSPHORSÄUREDERIVATE (II). (The permeability of protective clothing materials to insecticidal phosphoric acid derivatives (II).) J. prakt. Chem. 4 (1966) 37-40. (In German)

By using ^{32}P-labelled compounds it was possible to evaluate the permeability of 15 different rubber materials to certain insecticides of practical importance which are produced technically on a large scale. The permeability values were established for methyl parathion, dimethoate, butonate, and DDVP.

713 Dedek, W., Schwarz, H. STUDIUM ZUR PERCUTANEN RESORPTION ^{32}P-MARKIERTER SYSTEMISCHER, MINDERTOXISCHER ORGANOPHOSPHOR-VERBINDUNGEN (OPV) BEIM RIND. (Studies on the percutaneous resorption of ^{32}P-labelled systemic organophosphorus compounds of lesser toxicity in cattle.) Z. Naturf. 22b, 7 (1967) 702-708. (In German)

By using ^{32}P-labelled compounds on cattle skin in in vitro test runs it could be shown that percutaneous resorption of water-soluble systemic organophosphorus compounds in solution may be considered as a first approximation of a two-phase distribution. Radiochemical investigations of the active substance in blood, following cutaneous application by the pour-on method to cattle in vivo confirm this relation even under in vivo conditions, particularly for trichlorfon and dimethoate.

714 Dedek, W., Schwarz, H. STUDIEN ZUR APPLIKATION UND ZUM METABOLISMUS DES ^{32}P-MARKIERTEN SYSTEMINSEKTIZIDS DIMETHOATE BEIM RIND. (Studies on the application and metabolism of the ^{32}P-labelled systemic insecticide, dimethoate, in cattle.) Z. Naturf. 22 b, 11 (1967) 1166-1171. (In German, with German abstract only)

The less toxic ^{32}P-labelled dithiophosphoric acid ester, dimethoate, was applied by intramuscular injection and by the pour-on method. The concentrations of the extracted substances and the total ^{32}P-activity in blood and milk were determined. Attempts to identify the metabolites by radio-thin-layer chromatography gave some results. Intramuscular injection produced some relatively high concentrations of active substance in the blood, which were only broken down slowly. After percutaneous resorption of dimethoate from suitable formulations the active substance attains a concentration in the blood sufficient for the satisfactory killing of endoparasites, as confirmed in insecticide tests.

715 Dedek, W. METABOLISMUS UND RÜCKSTÄNDE VON ^{32}P-MARKIERTEM BUTONATE IN PFLANZEN UND TIEREN. (Metabolism and residues of ^{32}P-labelled butonate in plants and animals) Paper presented at the "6th International Congress of Plant Protection, Vienna, Austria, 30 Aug.-6 Sep. 1967". Abstr. B V-12. (In German)

The ^{32}P-labelled systemic mildly toxic ester of phosphonic acid butonate (O, O-dimethyl-1-butyryloxy-2, 2, 2-trichlorethylphosphonate) was sprayed on apples, plums and wheat. By means of selective extraction methods residues and half times were determined. Trichlorphon was identified as metabolite by radio thin-layer chromatography. In the same way the metabolism in the serum of mammals was studied. Besides dimethylphosphate and trichlorphon also desmethyl butonate seemed to be formed in little amounts. The concentration of butonate and trichlorphon in blood and milk after percutaneous resorption (pour-on treatment) by the cow was determined. The intramuscular injection is not suitable for application. The metabolism of butonate in the milk is discussed. (Abstr.)

716 Dedek, W., Schwarz, H. LOW-TOXICITY PHOSPHORUS-32-LABELED PHOSPHONIC ACID ESTER BUTONATE APPLICATION TO CATTLE. Arch. exp. VetMed. 21, 4 (1967) 1023-1030. (In German)

Butonate labelled with ^{32}P was applied to lactating cattle by intravenous and intramuscular injection and by body drenching. The radioactive half-life in blood was 3-4 min in vivo. Butonate and its metabolites were detected in both the blood and milk. Systemic activity was observed only by the drench method, due to the low solubility of the compound in H_2O. Pasteurized milk from cows treated with butonate is safe for drinking, since it contains only nontoxic metabolites. The compound applied by drench is satisfactory for the control of endoparasites. (CA 68: 1968, 86363d)

717 DUNN, E., Ward, A.H. THE MOVEMENT OF ^{32}PHOSPHORUS-LABELLED DIMETHOATE IN THE CACAO TREE, Theobroma cacao L. Ann. appl. Biol. 56 (1965) 419-428.

The movement and persistence of the systemic insecticide dimethoate and its metabolite in the cacao tree have been studied by the use of ^{32}P in Rogor 40(O, O-dimethyl S-(N-methylcarbamoylmethyl) phosphorodithioate). In trunk injection experiments only 11% of the insecticide entered effectively into the tree, and of this 83% remained within 1 ft of the point of injection. The remainder was quickly translocated upwards but was unevenly distributed in the canopy. Uptake of dimethoate from soil into the stem and branches proceeded continuously but slowly, and was much less than from injections. In mature pods, > 86% of the dimethoate was found to be degraded into non-toxic metabolites: thus there is little hazard from dimethoate residues in cacao beans. (From auth. summary)

718 Engst, R., Seidler, H., Haertig, M. THE BEHAVIOR AND THE DISTRIBUTION OF METHYL PARATHION-^{32}P IN CARROTS (Daucus carota). I. LABELING AND PERSISTENCE OF METHYL PARATHION. Nahrung 10, 5 (1966) 413-418. (In German)

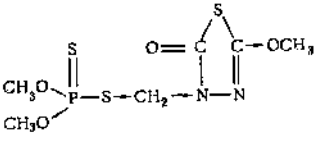
Duwicker and Marktgaertner strains of carrots were drenched with methyl parathion-^{32}P, 90 mg/l, at 6-133 d of age and with 40, 90, or 180 mg/l at 89-119 d of age, respectively. The Duwicker strain contained the most labelled residue (0.09 ppm) 28 d after a 90-mg/l drenching, whereas the Marktgaertner strain contained 7.0 ppm 14 d after 180 mg/l and 0.4 ppm 28 d after 40 mg/l. No methyl paraoxon was found, indicating that the degradation of absorbed methylparathion was very slow. (CA 66: 1967, 10004u)

719 Engst, R., Seidler, H., Haertig, M. THE BEHAVIOUR AND THE DISTRIBUTION OF METHYL PARATHION-^{32}P IN THE CARROT (Daucus carota). II. DISTRIBUTION AND HYDROLYSIS OF METHYLPARATHION-^{32}P. Nahrung 10, 5 (1966) 419-425. (In German)

Duwicker strain of carrots (D. carota) exposed from days 89 to 147 to 90 mg of methyl parathion-^{32}P/m incorporated 0.025 ppm of the label, whereas Marktgaertner strain incorporated 0.11 ppm into the integument; 0.007 and 0.008 ppm, respectively, was incorporated into the pith of these two carrot strains. The distribution of the label in the carrots was related to the amounts of essential oil present. During neutral hydrolysis in water or carrot juice, the carrot oil exerted a protective effect. Of the 5 P-containing degradation products separated by thin-layer chromatography, only monomethylphosphate and dimethylphosphate were positively identified. (CA 66: 1967, 10005x)

720 Esser, O., Müller, P.W. METABOLISM OF GS 13005, A NEW INSECTICIDE. Experientia 22, 1 (1966) 36-38. (In English)

GS 13005 is the active ingredient of a new insecticide of J.R. Geigy S.A., Basle, Switzerland, registered under the Trade mark of Supracide^R, with a structure O,O-dimethyl-S-[2-methoxy-1,3,4-thiadiazol-5-(4H)onyl-(4)methyl]-dithiophosphate



GS 13005, ^{14}C-labelled in the 5-position of the heterocycle, was synthesised by Dr. D.E. Ryskievich, Geigy Research Laboratories, Ardsley, N.Y. Its metabolism in plants was studied after application to young leaves of bean plants (Phaseolus vulgaris L.) and to freshly harvested apples, and in the rat. Considerable breakdown to CO_2 was found throughout. No accumulation of the intact insecticide or its metabolites was observed in either animals or plants.

721 Everett, L.J., Anderson, C.A., MacDougall, D. NATURE AND EXTENT OF GUTHION RESIDUES IN MILK AND TISSUES RESULTING FROM TREATED FORAGE. J. agric. Fd Chem. 14, 1 (1966) 47-55.

^{32}P-Guthion was used to determine total radioactivity in milk and urine. Blood samples were also counted directly after suitable dilution. Recoveries of ^{32}P-Guthion and its oxygen analogue from brain, fat, heart, kidney, liver, steak, and milk ranged from 87-100%. ^{14}C-Guthion was synthesised. After oral administration milk samples were examined. Results are generally illustrated by graphs. - Treatment of alfalfa with Guthion according to label recommendations will usually result in fresh forage residues of 1 ppm or less. Very occasionally residues in the 1.0-1.5-ppm range may be encountered. Use of such forage will not result in detectable residues in milk of either Guthion or its oxygen analogue or residues > 0.01 ppm of P-free metabolites containing the benzazimide structure. The exact nature of the metabolites has not been determined.

722 Ford, I.M., Menn, J.J., Meyding, G.D. METABOLISM OF N-(MERCAPTOMETHYL)-PHTHALIMIDE-CARBONYL-C^{14}-S-(O,O-DIMETHYL-PHOSPHORODITHIOATE)(IMIDAN-C^{14}): BALANCE STUDY IN THE RAT. J. agric. Fd Chem. 14, 1 (1966) 83-86.

The fate of Imidan-^{14}C labelled in the carbonyl carbon was determined following administration of a single oral dose to rats. 98% of the radioactive material was accounted for in studies with three male and two female rats. Of that recovered, 79% was excreted in the urine and 19% in the faeces at the time of sacrifice, either 72 or 120 h after treatment. Less than 1% of the administered compound appeared in the urine as Imidan or its phosphorothiolate analogue, N-(mercaptomethyl)-phthalimide-S-(O,O-dimethylphosphorothiolate)(Imidoxon). Tissue residues accounted for 2.6% of the administered radioactivity with no selective storage in any tissue. Little, if any (<0.04%), radioactivity was detected in the expired CO_2. (Auth.)

723 Fredriksson, T., Farrior, W.L., Jr., Witter, R.F. STUDIES ON THE PERCUTANEOUS ABSORPTION OF PARATHION AND PARAOXON. I. HYDROLYSIS AND METABOLISM WITHIN THE SKIN. Acta derm.-vener., Stockholm 41 (1961) 335.

Extensive studies were carried out. The ability of the skin of man, cat, rabbit, and rat to hydrolyse or otherwise metabolise paraoxon (E 600, or diethyl 4-nitrophenyl phosphate) or parathion (E 605, or diethyl 4-nitrophenyl thiononophosphate) was investigated using the Warburg technique and paper chromatography. Parathion was not hydrolysed or transformed into paraoxon by the skin of any of the species tested. ^{32}P-parathion was used. Paraoxon, on the other hand, was hydrolysed by skin from man, cat, and rabbit. This reaction, which was enzymic in nature, occurred at the fastest rate in the rabbit. In this tissue, about 20% of the paraoxon was hydrolysed in 1 h by 1 g of skin at 25°C, while only about 1% was converted by skin from man or cat. The relation of these findings to the percutaneous absorption of these compounds was discussed.

724 Fukami, J., Shishido, T. STUDIES ON THE SELECTIVE TOXICITIES OF ORGANIC PHOSPHOROUS INSECTICIDES. III. THE CHARACTERS OF THE ENZYME SYSTEM IN CLEAVAGE OF METHYL PARATHION TO DESMETHYL PARATHION IN THE SUPERNATANT OF SEVERAL SPECIES OF HOMOGENATES (Part I). Botyu-kagaku 28, 3 (1963) 77-81. (Japanese summary)

Investigations were carried out on the nature of the reaction system involved in the degradation of methyl-parathion (labelled with ^{32}P) to desmethyl-parathion in tissue homogenates of mammals and insects. The rate of the reaction, the optimum pH values and the effects of cofactors, various inhibitors and ions and lack of oxygen on the reaction system were examined. It is assumed that the reaction in the supernatant of the rat-liver homogenate is due to hydrolysis and not to oxidation. It is concluded that the reaction was a type of enzyme reaction, SH groups playing an essential part. Of several organs of the rat studied, the liver showed the highest degradation activity, and similar results were obtained with rabbit and guineapig. There was no degradation activity in the blood of larvae of C. suppressalis or Xylotrupes dichotomus (L.) or in the subcellular fraction of the blood of the latter. It appears that the reaction system involved in the degradation of methyl-parathion to desmethyl-parathion in the supernatant of rat-liver homogenate is not the same as A-esterase or paraoxonase. (RAE-A 55: 67, ref. 198)

725 Fukami, J., Shishido, T. NATURE OF A SOLUBLE, GLUTATHIONE-DEPENDENT ENZYME SYSTEM ACTIVE IN CLEAVAGE OF METHYL PARATHION TO DESMETHYL PARATHION. J. econ. Ent. 59, 6 (1966) 1338-1346.

Larvae of the horn beetle, Xylotrupes dichotomus (L.) (3rd instar, under hibernation) and of Bombyx mori (L.) (5th instar, in feeding period) were used. The specific activities of ^{32}P-labelled methyl parathion and Sumithion as used were 10-15 mCi/g. Homogenates of the various tissues were prepared, the incubation mixture consisting of 2.4 ml of homogenate tissue 4 x 10^{-3}M of cofactor and 0.3 ml of labelled insecticide (1.0 mg/ml), in a final volume of 3.0 ml, pH 7.4. The nature of the enzyme, in the supernatant fraction of tissue homogenates of rat liver and insect mid-gut, that cleaves O, O-dimethyl O-p-nitrophenyl phosphorothioate (methyl parathion) to O-methyl O-p-nitrophenyl phosphorothioate (desmethyl parathion) was examined. The enzyme, from both sources, is inactivated by dialysis or gel filtration and its activity is effectively restored by addition of reduced glutathione (GSH). Many rat tissues are active in methyl parathion-demethylation, but highest activity occurs in the liver. Although the addition of GSH increases the activity of insect midgut and fat body, these insect enzymes fall short of the degrading activity of rat liver. The degradation product of methyl parathion as formed by the supernatant fraction of rat liver fortified with GSH was identified as the desmethyl derivation. Two metabolites, the desmethyl derivative and phosphoric acid, were detected from the insect mid-gut preparations when fortified with GSH. Rat liver has approx. 5.5 times as much GSH as the midgut of larvae of horn beetle, X. dichotomus (L.). Cellulose chromatographic separation of the supernatant of rat liver and insect midgut homogenates reveals that the nature of these two enzyme proteins is different. The metabolic difference in the degradation of organophorphorus insecticides containing the P-O-methyl between mammals and insects is discussed in relation to the selective toxicity of these compounds.

726 Gage, J.C. METABOLISM OF MENAZON [O, O -DIMETHYL S-(4, 6-DIAMINO-s-TRIAZIN-2-YLMETHYL)PHOSPHORODITHIOATE] IN THE RAT. Fd Cosmet. Toxic. 5, 3 (1967) 349-357.

At least 80% of an oral dose of menazon-^{14}C to rats appears in the urine within 24 h. The urine contains no unchanged menazon. The major metabolites in urine are the O analogue of menazon, its demethyl derivative, and 2 methylsulfinylmethyl-4, 6-diamino-s-triazine which must derive from hydrolysis of menazon to give the thiomethyl-triazine, followed by methylation and oxidation at the S atom to give the sulfoxide. A small proportion of the dose is probably also excreted as 2-methoxymethyl-4, 6-diamino-s-triazine. These metabolites represent about 80% of the radioactivity excreted; small amounts of three other basic metabolites were also detected, but were not identified. A scheme is proposed for the metabolism of menazon in the rat. (CA 67: 1967, 107616r)

727 Gatterdam, P.E., Wozniak, L.A., Bullock, M.W., Parks, G.L., Boyd, J.E. ABSORPTION, METABOLISM, AND EXCRETION OF TRITIUM-LABELED FAMPHUR IN THE SHEEP AND CALF. J. agric. Fd Chem. 15, 5 (1967) 845-853.

^{3}H-famphur, O-demethyl famphur [O-methyl O, p-(N, N-dimethylsulfamoyl)phenyl phosphate, cyclohexylamine salt] and p-(N, N-dimethyl-sulfamoyl)phenol, containing, respectively, 241 and 330 μCi/g ^{3}H, were used and their synthesis is described. The metabolism of famphur, O, O-dimethyl O, p-(N, N-dimethylsulfamoyl)phenyl phosphorothioate, in the sheep and calf involves rupture of P-O-methyl, P-O-phenyl, and N-methyl bonds to yield water-soluble metabolites which are eliminated in the urine. Phenolic metabolites are excreted primarily as glucuronide derivatives. Marked differences in metabolism and excretion patterns occur depending on the method of administration, intramuscular injection providing more sustained famphur levels, and lower famoxon levels in blood than intravenous administration.

728 Getzin, L.W., Rosefield, I. PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOILS. J. econ. Ent. 59 (1966) 512-516.

The persistence of ^{14}C-labelled diazinon and Zinophos ®/O, O-diethyl O-2-pyrazinyl phosphorothioate) was determined in four soils under laboratory conditions at 25°C. Treated soils were extracted at intervals with equal amounts of acetone and 0.05N CaCl$_2$ to remove the insecticide and its degradation products. The initial recovery of both insecticides was greater than 94%. The disappearance rate of ^{14}C-diazinon was similar in the four soils. One-half of the original applications was lost in 2-4 weeks and less than 8% remained after 20 weeks. The persistence of ^{14}C-Zinophos varied considerably in the four soils. The time required for 50% loss in an organic soil, sandy loam, silt loam, and

clay loam was approx. 10, 6, 4, and 1.5 weeks, respectively. After 24 weeks 2-27% of the original applications remained. Non-extractable radioactivity at the end of the experiment represented 20-30% of the original applications. ^{14}C from soil treated with ethoxy-labelled diazinon and pyrazinyl-labelled Zinophos was lost to the atmosphere as $^{14}CO_2$. In field trials diazinon and Zinophos were applied to a silt loam at rates of 5 and 6 lb/acre, respectively. Insecticide residues were measured at intervals by gas chromatography. A rapid loss of toxicant during the first eight weeks after treatment was followed by a much slower decline with both insecticides. After 24 weeks approx. 10% of the original applications remained. Degradation curves for the laboratory and field experiments were similar. (Auth.)

729 Getzin, L.W. METABOLISM OF DIAZINON AND ZINOPHOS IN SOILS. J. econ. Ent. 60, 2 (1967) 505-508.

The identity and persistence of degradation compounds associated with the decomposition of ^{14}C ring-labelled diazinon* and Zinophos ®(O,O-diethyl O-2-pyrazinyl phosphorothioate)** were determined in a silt loam by thin-layer and gas-liquid chromatography. A primary degradative pathway of the insecticides is hydrolysis at the heterocyclic phosphate bond, followed by disruption of the cyclic moiety with subsequent formation of $^{14}CO_2$. After 20 weeks at 25°C, 10 to 15% of the insecticides remained. Of the ^{14}C from diazinon and Zinophos, 35 and 60% respectively, were evolved as $^{14}CO_2$. A radioactive hydrolysis product, 2-isopropyl-4-methyl-6-hydroxy-pyrimidine was extracted from soil treated with diazinon, but 2-pyrazinol, the expected hydrolysis product of Zinophos, was not identified positively in non-sterile soil. Greater amounts of the hydrolysis compounds were recovered from fumigated soil in which the microbial activity was reduced, than from non-fumigated soil. Conversely, little $^{14}CO_2$ was released from the fumigated soil. The oxygen analogues of diazinon and Zinophos were not detected in soil treated with the parent compounds.

* at the 2-position of the pyrimidine ring.
** labelled in the 3-position of the pyrazinal ring.

730 Gunner, H.B., Zuckerman, B.M., Walker, R.W., Miller, C.W., Deubert, K.H., Longley, R.E. THE DISTRIBUTION AND PERSISTENCE OF DIAZINON APPLIED TO PLANT AND SOIL AND ITS INFLUENCE ON RHIZOSPHERE AND SOIL MICROFLORA. Pl. Soil 25, 2 (1966) 249-264.

^{14}C-Diazinon was used, labelled on the C^1 of the ethyl ester, with a specific activity of 3.21 µCi/mg, diluted 1: 800 in either water or hexane prior to application. The rapid translocation of Diazinon through bean plants and its emergence in bean root exudates maintained under sterile conditions could be demonstrated. The presence of bean rhizosphere microflora did not appear to be a factor in the metabolism of Diazinon by the bean plant. Diazinon applied at the rate of 3 lbs per acre to soil under non-sterile conditions persisted for as long as 180 d after application. No Diazinon was detectable after ten weeks in soil receiving 0.3 lbs per acre. Diazinon or its degradation products exerted a selective effect common to both soil and rhizosphere microflora which expressed itself in the selective enrichment of a cocoidal rod. Numbers of fungi seemed unaffected by the presence of Diazinon. After 180 d a large number of the genus Streptomyces appeared as a seeming climax population. The predominant microbial isolate utilized Diazinon as a S, P, C and N source in that order of preference. The biodegradability of Diazinon was conditioned by its solubilization in a suitable carrier, and by the presence of an additional carbon source.

731 Harris, L.W., Fleisher, J.H., Clark, J., Cliff, W.J. DEALKYLATION AND LOSS OF CAPACITY FOR REACTIVATION OF CHOLINESTERASE INHIBITED BY SARIN. Science, N.Y. 154 (1966) 404-406.

Inhibition of rat brain acetylcholinesterase by ^{32}P-sarin in vivo results initially in ^{32}P-isopropylmethylphosphonylated enzyme. The percentage of inhibited enzyme that could not be reactivated by pyridinium aldoxime methochloride (aged enzyme) approximated the amount of radioactivity identified as ^{32}P-methylphosphonate. The ^{32}P-isopropyl methylphosphonate not released from the inhibited enzyme by the oxime accounted for 51 ± 10% (standard deviation) of the radioactivity fixed to brain tissue. It showed no correlation with aging and was probably bound to sites other than acetylcholinesterase. (Auth.)

732 Hassan, A., Zayed, S.M.A.D., Mostafa, I.Y. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. VIII. DEMETHYLATION OF DIPTEREX. Z. Naturf. 21b (1966) 498-500. (In English)

The fate of the methyl groups of Dipterex in cotton plant (Gossypium barbadense) and in fungus (Fusarium sp.) was investigated using ^{14}C-Dipterex, the two methyl groups being labelled with ^{14}C. Plants, two weeks old, were immersed in a solution containing ^{14}C-Dipterex (20 mg/20 ml) for 3 d. The ^{14}C-atoms of the methyl groups were found to be incorporated into a chloroform-soluble substance containing no P. Dipterex degradation by the fungus was studied by incubating it for 10 d. The absence of the oxidative pathway : methanol → formaldehyde → formate → CO_2 is clearly indicated. On the basis of these and previous results (published elsewhere) it was concluded that the detoxification of the insecticide in vivo proceeded as follows: (a) in the rat: exclusive hydrolysis of the phosphonate bond of both Dipterex and its demethylated metabolite; (b) in Prodenia larvae: 70% hydrolysis of O-methyl ester linkages and 30% splitting of C-P bond; (c) in cotton plant: hydrolysis of the phosphonate bond, followed by demethylation of the methylated phosphates; (d) in microorganisms: exclusive hydrolysis of O-methyl ester bond(s).

733 Hollingsworth, R. M. DESALKYLATION AND TOXICITY OF ORGANOPHOSPHATES. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 40, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

The detailed in vitro metabolism of ^{14}C-labelled methyl paraoxon was examined in mammalian liver fractions and compared to metabolism of the same compound in vivo. The relative importance of competing pathways of metabolism was determined with several other organophosphates and related to mammalian toxicity. (Abstr.)

734 Hollingsworth, R. M., Metcalf, R. L., Fukuto, T. R. THE SELECTIVITY OF SUMITHION COMPARED WITH METHYL PARATHION METABOLISM IN THE WHITE MOUSE. J. agric. Fd Chem. 15, 2 (1967) 242-249.

The metabolism of ^{32}P-labelled methyl parathion and its 3-methyl analogue, Sumithion, has been studied in the white mouse at a series of dosage levels in further investigation of the low mammalian toxicity of Sumithion. The metabolism of the corresponding methylphosphonothionate analogues of methyl parathion and Sumithion also has been investigated. Seven of the eight metabolites of methyl parathion and Sumithion excreted in mouse urine have been identified. All are products of hydrolysis and oxidation. No pronounced differences were observed between these two compounds either in pattern of metabolism or the rate of excretion of metabolites. Evidence is presented that the high selectivity level of Sumithion depends on the ability of the system cleaving the P-O-alkyl bond to play an enhanced role in detoxication as the dosage is increased. This situation is particularly evident with the analogous phosphonothionates, where little desmethylation occurs and the selectivity level of the Sumithion analogue is greatly reduced. (Auth.)

735 Hollingsworth, R. M., Metcalf, R. L., Fukuto, T. R. THE SELECTIVITY OF SUMITHION COMPARED WITH METHYL PARATHION METABOLISM IN SUSCEPTIBLE AND RESISTANT HOUSEFLIES. J. agric. Fd Chem. 15, 2 (1967) 250-255.

The metabolism and fate of methyl parathion and Sumithion has been studied in OP S-and-R house flies in an investigation of the nature of the resistance mechanism. The two compounds behaved almost identically with respect to penetration, activation and degradation in the two strains. Resistance was attributed to the presence of enhanced phosphatase activity in the resistant strain which resulted in greater degradation of the activation products, methyl paraoxon and Sumioxon, and thus a 3-to 4-fold lower level of these active toxicants was present in the resistant strain. A secondary factor in resistance may be the slower penetration into the resistant flies. The high level of resistance could be at least partially attributed to saturation of the penetration and activation mechanisms at high dosage levels, which leads to a decreased rate of accumulation of the activation product. At the same time, the over-all rate of degradation of these insecticides by the resistant flies at the high dosage was still as great as with the susceptible flies at the low dosage. (Auth.)

736 Hollingsworth, R. M. BIOCHEMICAL FACTORS DETERMINING SELECTIVE TOXICITY OF THE INSECTICIDE SUMITHION AND ITS ANALOGS. Diss. Abstr. 27 (1966) 340-B - 341-B.

A study was made of the chemistry, metabolism and general toxicology of Sumithion (O, O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate) and some of its analogues in order to explain its very low mammalian toxicity. Methyl parathion (O, O-dimethyl O-p-nitrophenyl phosphorothioate) or its appropriate analogue was used as a reference compound in each case. Similar studies were carried

out with organophosphorus resistant and susceptible house flies in an attempt to explain the nature of the resistance process. Metabolism of Sumithion and methyl parathion in mice was investigated with ^{32}P-labelled compounds by ion-exchange, paper and thin-layer chromatography. All the major metabolites in the urine after oral dosage were identified. No significant differences existed between the compounds in their rates of excretion, or in the types and amounts of the different metabolites produced from them. A clear increase in the importance of desmethylation as a detoxifying system was noted as the dosage increased. Evidence from several sources suggests that desmethylation is a crucial factor in the low mammalian toxicity of Sumithion. Analogous metabolic studies with the very toxic phosphono analogues of Sumithion and methyl parathion suggest that little desmethylation occurs with these compounds. (From DA)

737 Hutson, D.H., Akintonwa, D.A.A., Hathway, D.E. THE METABOLISM OF 2-CHLORO-1-(2',4'-DICHLOROPHENYL)-VINYL DIETHYL PHOSPHATE (CHLORFENVINPHOS) IN THE DOG AND RAT. Biochem. J. 102 (1967) 138-142.

A single oral dose of chlorfenvinphos-^{14}C to rats was quantitatively eliminated in 4 d. Rats did not show a sex difference in the elimination pattern and showed only a small degree of biological variation in the total excretion data. Of the label, 87.2% was excreted in the urine (67.5% in the 1st day after dosage), 11.2% in the faeces, and 1.4% in the expired gases; <0.9% of ^{14}C was present in the gut and contents after 4 d. After oral administration of chlorfenvinphos-^{14}C to dogs, 94.0% (91.8-97.6%) of the ^{14}C was excreted in the urine and faeces during 4 d. Dogs did not show a sex difference in the pattern of elimination, and excretion of radioactivity in the urine was very rapid: 86.0% of ^{14}C during 0-24 h. Chlorfenvinphos was completely metabolised in rats and dogs; unchanged chlorfenvinphos was absent from the urine and from the carcass, when elimination was complete. In rats, 2-chloro-1-(2',4'-dichlorophenyl)vinyl ethyl hydrogen phosphate accounted for 32.3% of a dose of chlorfenvinphos, [1-(2',4'-dichlorophenyl)-ethyl β-D-glucopyranosid]uronic acid for 41.0%, 2,4-dichloro-mandelic acid for 7.0%, 2,4-dichlorophenylethanediol glucuronide for 2.6%, and 2,4-dichlorohippuric acid for 4.3%; in dogs, 2-chloro-1-(2',4'-dichlorophenyl)vinyl ethyl hydrogen phosphate accounts for 69.6%, [1-(2',4'-dichlorophenyl)ethyl β-D-glucopyranosid] uronic acid for 3.6%, 2,4-dichloromandelic acid for 13.4%, and 2,4-dichlorophenylethanediol glucuronide for 2.7%. Dogs and rats showed a species difference in the rate of excretion of ^{14}C in the urine, and in the proportions of the metabolites, with the exception of 2,4-dichlorophenylethanediol glucuronide, that are excreted in the urine. Alternative explanations for the latter species difference are suggested. 2-Chloro-1-(2',4'-dichlorophenyl)vinyl ethyl hydrogen phosphate and 2,4-dichlorophenacyl chloride probably lie on the main metabolic pathway of chlorfenvinphos since, in common with that insecticide, they give rise to [1-(2',4'-dichlorophenyl)ethyl β-D-glucopyranosid] uronic acid and 2,4-dichloromandelic acid as major metabolites in the urine. The proposed scheme for the metabolism of chlorfenvinphos represents a detoxication mechanism. (CA 66: 1967, 1818s)

738 Immel, R., Stiasni, M. A CONTRIBUTION TO THE ACTION OF THE INSECTICIDE BROMOPHOS (O,O-DIMETHYL-O-2,5-DICHLORO-4-BROMOPHENYL THIONOPHOSPHATE) IN AND ON PLANTS. p. 506-513 of "3rd British Insecticide and Fungicide Conference 1965. Proceedings. Brighton, Sussex, England. 8-11 Nov. 1965".

Reports investigations on the translaminar effect of bromophos, which was studied by means of bromophos labelled with ^{32}P, following earlier tests showing that when this compound is applied to leaves, it penetrates the surface and is effective against leaf-mining insects, though it is not translocated in the sap of plants. (RAE-A 55: 1967, ref. 577)

739 International Atomic Energy Agency, Vienna (Austria). THE APPLICATION OF RADIOISOTOPES TO STUDY THE MODE OF ACTION OF PESTICIDES USED AGAINST PLANT VIRUSES AND THEIR INSECT VECTORS. Research contract 236. p. 69-71 of "IAEA Research Contracts. Eight Annual Report". Technical Reports Series No. 85. Vienna, International Atomic Energy Agency. 1967, 142p. STI/DOC/ 10/85.

Research Institution: Faculty of Agriculture, Nagoya University, Nagoya, Japan.
Principal scientific investigator: T. Hira. Period of contract: 1 Oct. 1963 - 30 Nov. 1966.

The degradation of isotopically labelled organophosphate insecticides, trichlorfon [dimethyl (2,2,2-trichloro-1-hydroxyethyl) phosphonate] and the chemically related NS-2662 [dimethyl (2,2-dichloro-1-hydroxyethyl) phosphonate] revealed a more rapid degradation in sucking than in chewing insects.

Chewing insects are not generally vectors of plant viruses. Dimethoate and vamidethion showed a selective action against sucking insects. On soil application, both insecticides penetrated to rice plants and moved to felicar parts. Blasticidin S, an effective antiviral antibiotic, was labelled with ^{14}C and found to inhibit the virus-transmitting activity of insect vectors (leafhoppers fed on rice plants). It was found to penetrate into insects and inhibit virus synthesis, especially in the salivary gland.

740 Ivey, M.C., Claborn, H.V., Hoffman, R.A., Graham, O.H., Palmer, J.S., Radeleff, R.D. RESIDUES OF SHELL COMPOUND 4072 IN THE BODY TISSUES OF SPRAYED CATTLE. J. econ. Ent. 59, 2 (1966) 379-382.

Studies were made to determine whether the use of Shell Compound 4072 (2-chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate) sprayed on cattle at a concentration adequate for insect control would cause residues to accumulate in the body tissues. The low residues of the chemical found in the tissues after spray application were preponderant in the fat and were eliminated in 28 d or less. The tissues were analysed also for 2,2',4'-trichloroacetophenone, a likely metabolite, but no residues of this chemical were detected in any of the body tissues. In two of the three sets of experiments ^{32}P-labelled 4072 was used.

741 Iya, V.K., Mani, R.S., Desai, C.N. et al. PREPARATION OF SOME SPECIAL RADIOISOTOPE LABELLED COMPOUNDS AT TROMBAY. p. 218-222 of "Nuclear and Radiation Chemistry. Proceedings of a Symposium. Bombay, India, 1966". Bombay, Department of Atomic Energy.

Methods were developed at Trombay for the preparation of ^{32}P-labelled insecticides (malathion and parathion).

742 Jacquinot, L. STUDY WITH ^{35}S OF INSECTICIDE PHORATE RESIDUE ON MILLET. Inst. Rech. agron trop. cult. Vivrieres, Bull. 21 (1966) 173-180.

743 Jezdic, V., Skakun, M., Konstantinovic, S. SYNTHESIS OF MALATHION LABELED WITH ^{35}S OR ^{32}P AND DIPTEREX-^{32}P. Bull. Boris Kidrich Inst. nucl. Sci. 17 (1966) 29-37.

Malathion and dipterex are two of the group of organophosphorus compounds that are widely applied in agriculture as insecticides. In order to study the effect of malathion and dipterex as insecticides, methods were worked out for their synthesis with incorporated radioactive isotopes ^{32}P and ^{35}S. The syntheses described are simple and give greater yields than those previously reported. (Auth.)

744 Kansouh, A.S.H. DIAZINON ABSORPTION, METABOLISM, AND PERSISTENCE IN WHEAT GRAIN AND BEAN PLANTS, Phaseolus vulgaris. Diss. Abstr. 28, 5 (1967) 1975-B - 1976-B.

This study investigated the absorption of diazinon in wheat grain and plant tissues, its persistence, translocation, possible conversion to more toxic compounds, and identification of metabolites or degradation products. ^{14}C-diazinon in conjunction with thin-layer and paper chromatography was used to study metabolites or degradation products in wheat grain. ^{14}C-2-isopropyl-4-methyl-pyrimidin-6-ol appeared in small amounts after 30 d in wheat grain and on glass beads. Atmospheric moisture and aging factors could cause diazinon hydrolysis on either substrate, as well as enzymic activity in wheat grain. Bean plants were treated with aqueous solutions of ^{14}C-diazinon using root absorption, stem injection, and petiole absorption by excised leaves and held under controlled conditions of temperature and photoperiod. ^{14}C-2-isopropyl-4-methylpyrimidin-6-ol was the only metabolite detected in plant extracts of all treatments by chromatogram scanning or autoradiography. Chromatograms of excised leaf extracts indicated the hydrolysis of ^{14}C-diazinon at 8 h after treatment with a max. amount at 5 d. Both ^{14}C-diazinon and its hydrolysis product, were completely lost at 22 d after treatment. In another experiment it was found that trace quantities of ^{14}C-diazinon in the excised leaves were converted to $^{14}CO_2$ with maximum production at 24 h after treatment. Both ^{14}C-diazinon and ^{14}C-2-isopropyl-4-methylpyrimidin-6-ol were detected in plant tissues and nutrient solution at 84 h after treatment showing translocation of these compounds from the leaf into the nutrient solution. $^{14}CO_2$ was also produced from ^{14}C-diazinon absorbed through bean plant roots, increasing from 0.068-0.110% of the original amount absorbed when treated with 8.0 and 20.0 ppm, respectively. The $^{14}CO_2$ was respired in smaller quantities during light periods than during dark periods corresponding to the cycles of photosynthesis. ^{14}C-2-isopropyl-4-methyl-pyrimidin-6-ol and diazinon were detected in the plant homogenates and the nutrient solution at

6 d after treatment, demonstrating translocation and exudation of these compounds from the roots. Hydrolysis of the phosphorus pyrimidinyl ester linkage was the only significant mechanism for diazinon metabolism by bean plants. Only trace amounts of the original diazinon absorbed were converted to $^{14}CO_2$ in 6 d, thus indicating the stability of 2-isopropyl-4-methylpyrimidin-6-ol. ^{14}C-diazoxon was not detected in plant tissues or nutrient solution, indicating that P=S oxidation did not occur to any appreciable extent in the bean plant. (From DA)

745 Katague, D.B., Anderson, C.A. METABOLISM OF ^{32}P-LABELED DASANIT IN COTTON PLANTS. Bull. envir. Cont. Toxicol. 2, 4 (1967) 228-235.

When applied directly to the stems or taken up by the roots of young cotton plants, ^{32}P-labelled Dasanit (O,O-di-Et O-p-(methylsulfinyl) phenyl phosphorothioate) was metabolised in 4-9 d to the ^{32}P-labelled Dasanit O analogue (3.5-7.2% of the isolated organosoluble ^{32}P), labelled Dasanit sulfone (8.2-12.0%), and a trace amount of the Dasanit O analogue sulfone. However, most (79.9-88.3%) of the isolated organosoluble ^{32}P was in the form of the parent compound. No S-Et analogues were found. (CA 67: 1967, 52973)

746 Knowles, C.O., Arthur, B.W. RESIDUES ASSOCIATED WITH BACKRUBBER APPLICATION OF RONNEL TO DAIRY COWS. J. econ. Ent. 59 (1966) 752-753.

^{32}P-ronnel was synthesised from ^{32}P-thiophosphoryl chloride, and a solution applied to two Jersey cows in an advanced stage of lactation but still producing 13.7 lb/head/d; a total area of 24 in. x 50 in. was treated. Cows were treated after morning and evening milkings for seven consecutive days. No detectable residues (lower limit or sensitivity 0.02 ppm) were present in the milk analysed for total ^{32}P materials or in various fractions of the milk (acetonitrile, n-hexane, water, and unextractable). Most of the radioactive materials eliminated in the urine were hydrolytic products, based on chloroform to water partition data. No data as to peak concentration of ^{32}P-materials were obtained as no samples were collected during the first 4 d of the experiment. No detectable ^{32}P-materials were present in any of the faecal samples. The hair samples contained ~147 ppm of radioactive materials after the 1st treatment, residues declining to ~2.9 ppm by 14 d after the initial treatment. Half an hour after the 1st treatment >98% of the radioactive material partitioned into the chloroform; 10 d later this portion had dropped to 48%. Ronnel had evidently undergone conversion on the hair to a more polar material(s).

747 Knowles, C.O., Arthur, B.W. METABOLISM OF AND RESIDUES ASSOCIATED WITH DERMAL AND INTRAMUSCULAR APPLICATION OF RADIOLABELED FENTHION TO DAIRY COWS. J. econ. Ent. 59, 6 (1966) 1346-1352.

^{32}P-labelled fenthion having a specific activity of 5.0 mCi/g was formulated as a 0.5% emulsion and applied dermally to 2 dairy cows at a rate of 1 qt per cow. Two other lactating cows were treated intramuscularly with 3.5 g of fenthion (8.6 mCi/g) per cow. Fenthion and certain oxidative metabolites were isolated from milk, urine, and faeces following either method of treatment. The ratio of these metabolites in the urine was vastly different from that in the faeces. Fenthion was rapidly degraded to phosphoric acid derivatives and was eliminated primarily in the urine and to a lesser extent in the faeces. Residues were negligible in edible tissues 14 d after dermal treatment, but persisted throughout the 21 d test period in cows treated intramuscularly. Mortality of the house fly, Musca domestica L., and the stable fly, Stomoxys calcitrans (L.), caged on cows treated dermally with fenthion was 100% at 1 d after treatment. (Auth.)

748 Koch., H., Abendroth, C. UNTERSUCHUNG ZUR ANWENDUNG VON P-32-MARKIERTEM DIMEFOX IM HOPFENBAU. (Study connected with the application of ^{32}P-labelled dimefox to hop growing.) p.149-150 of "Arbeitstagung Angewandte Radioaktivität. Leipzig, German Democratic Republic, 11-14 Oct. 1966". Deutsche Akademie der Wissenschaften zu Berlin. Institut für Angewandte Radioaktivität. 1967, 154 p. Abstr. (In German)

The synthesis of labelled dimefox [bis(dimethylamino)-phosphorylfluoride] is described. The hydrolytic breakdown in vitro involving acid and alkaline reactions was investigated. The hydrolysis of dimefox catalysed by acidity is initiated by a break in the P-N bond, leading to phosphoric acid via unstable intermediate products. Hydrolysis under alkaline conditions, on the other hand, splits the P-F bond to lead to the relatively stable bis(dimethylamino)-phosphoric acid or its salt which is broken down in additional reactions to give phosphoric acid. The speed of uptake following

root and foliage application was studied in the laboratory. Only slight uptake was found in the leaf surface due to the low lipid solubility of the compounds. A high rate of uptake could, however, be observed after root treatment with a culture solution containing active substance, where selective absorption from the solution took place. In field experiments on hop plants at different stages of development, the uptake in younger plants was limited to a shorter period. Using injected plants it was found that the active substance is mainly carried along in the direction of transpiration and that only small quantities were retained by assimilation. In order to determine the duration of insecticide effectiveness, residues in plant leaves were determined at different intervals. The concentration of active substance found in the leaves ensured protection against aphid attack for the whole experimental period which was also confirmed by a biological test.

749 Konrad, J.G., Armstrong, D.E., Chesters, G. SOIL DEGRADATION OF DIAZINON, A PHOSPHOROTHIOATE INSECTICIDE. Agron. J. 59, 6 (1967) 591-594.

Aqueous diazinon solutions equilibrated with the Ella loamy sand, an AC Prairie soil, Kewaunee clay, a gray brown podzolic, and Poygan silty clay, a humic gley, showed an initial rapid decrease in solution concentration of diazinon resulting from soil adsorption. Following adsorption, a slow but continual decrease in diazinon concentration was observed and attributed to degradation. For all soils, the total ^{14}C activity decreased initially due to adsorption of diazinon but increased on prolongued incubation as the degradation products of diazinon were liberated into solution. The reactions of diazinon in soil were a rapid adsorption followed by degradation at the adsorption sites and release of the degradation products into solution. For each of the soils data indicate that degradation rates are related closely to the extent of initial soil adsorption. Adsorption was more extensive and release of degradation products to solution more rapid in the Poygan than in the other two soils in which release of degradation products was similar, as was the initial adsorption. The extents of diazinon adsorption and degradation rates depend on the pH of the soils, organic matter content, and clay content of the soils. Adsorption increases with increasing organic matter and clay content. In soil-free systems under acid conditions diazinon hydrolysis is a major mechanism of degradation and the rate of hydrolysis is controlled by the pH of the system. Diazinon hydrolysis in aqueous systems can be acid- or alkali-catalysed. From the results it was concluded that the mechanism of diazinon degradation in soils is a partial chemical hydrolysis with the formation of the ring-labelled 2-isopropyl-4-methyl-6-hydroxypyrimidine and diethylthiophosphoric acid, the predominant chain-labelled degradation products of diazinon in soil, and both compounds were stable in terms of the length of these experiments (10 d). (CA 68: 1968, 11914f)

750 Labadan, R.M. COMPARATIVE EFFECT OF SELECTION IN THE LARVAL AND ADULT STAGES ON DEVELOPMENT OF ORGANOPHOSPHOROUS INSECTICIDE RESISTANCE IN THE HOUSE FLY. Diss. Abstr. 28, 1 (1967) 222-B.

Control of house flies by residual deposits of insecticides on the walls and ceilings of barns is known to cause resistance in adult flies. It is probable that during spraying accidental manure contamination results in the treatment of larvae. Larval selection probably occurs, as well as adult selection. A comparative study was undertaken in the laboratory to determine relative effects of larval and adult selection on development of resistance. In addition, cross-resistance of diazinon resistant larvae was determined. Finally, permeability of the larval cuticle was studied by means of radioactive diazinon, to determine role of permeability in larval resistance. — Results obtained by larval dipping showed larval resistance in all eight strains collected from New York State. LC 50's could not be determined as 1% diazinon emulsion gave mortalities less than 50% for all strains used. The LC 50 for the Wilson susceptible strain was 0.0055% diazinon. Selection during the larval stage gave rapid development of diazinon resistance. It was found that an immediate increase of resistance occurred in the F_1 generation to such a high degree that no further increase occurred. Since three unrelated strains used in this study give similar results, the bimodal status of New York State house fly resistance to diazinon appears to be a general situation. Selection during the adult stage indicated that the resistance level increased much less rapidly. Adult selection was not rigorous. Evidence was not found of a bimodal status for adults. Cross resistance studies by larval dipping of a diazinon resistant strain showed fenthion, dichlorvos and Compound 4072 highly toxic. Six other insecticides gave low to moderate mortalities while ten were non-toxic at 1% concentration. Loss of adult resistance when insecticide pressure is relaxed was found for two strains in 1962 and four strains in 1963. Larval dipping tests showed slight reversion to susceptibility after ten months without selection. This is the first report of larval loss of resistance to diazinon. Cuticular permeability studies showed no significant differ-

ence between diazinon resistant and susceptible strains in the rate of penetration. On this basis, it is suggested that larval resistance to diazinon is not due to penetration but to other mechanisms unknown at present. (From DA)

751 Lindquist, D.A., Bull, D.L. FATE OF 3-HYDROXY-N-METHYL-CIS-CROTONAMIDE DIMETHYL PHOSPHATE IN COTTON PLANTS. J. agric. Fd Chem. 15, 2 (1967) 267-269.

Azodrin (3-hydroxy-N-methyl-cis-crotonamide dimethyl phosphate, Shell SD-9129) is a substituted vinylphosphate insecticide that appears promising as a foliar spray and a systemic for the control of several insect pests. Azodrin is similar to that of the closely related vinyl phosphate, Bidrin (3-hydroxy-N, N-dimethyl-cis-crotonamide dimethyl phosphate). ^{32}P-Azodrin (4.1 and 10 mCi/g) and ^{32}P-Bidrin (12 mCi/g) were used. The nature and rate of metabolism of Azodrin (3-hydroxy-N-methyl-cis-crotonamide dimethyl phosphate) were studied in cotton plants. Oxidative conversion of Azodrin to its N-methylol derivative was of minor importance. The primary sites of hydrolytic degradation were at the vinyl-phosphate bond and one methyl-phosphate bond. The half life of Azodrin in cotton leaves was about 7 d. Azodrin was rapidly lost from the surface of cotton leaves following foliar application.

752 Lloyd, J.E., Mathysse, J.G. POLYMER-INSECTICIDE SYSTEMS FOR USE AS LIVESTOCK FEED ADDITIVES. J. econ. Ent. 59, 2 (1966) 363-367.

Polymer-insecticide feed-additive larvicides were developed for minimum insecticide loss in livestock and max. release in manure. O-methyl-^{3}H dimethoate, bis-ethyl-1-^{14}C diazinon, 2-^{3}H-phenyl famphur, 1-^{14}C-vinyl dichlorvos, and O-^{14}C dimetilan were used in studying insecticide release. Rates of ^{14}C and ^{3}H tagged insecticide elution were determined in vitro aqueous and in the digestive tract of cattle. Greater insecticide water-solubility and polymer flexibility and smaller particle size increased insecticide elution rate. Inclusion of polymer fillers also controlled elution rate. Rates of release were uniform. Polyvinyl chloride was the most promising polymer.

753 Lucier, G.W., Menzer, R.E. METABOLISM OF DIMETHOATE IN BEANS IN RELATION TO MODE OF APPLICATION. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 44, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Metabolism of ^{32}P- and ^{14}C-dimethoate in beans was studied using four modes of application. The oxygen analogue was formed in all cases. Variations were observed in the amount of hydrolysis products formed, although no product accumulated in large amounts. High levels of radioactivity were found in the plant pulp and pigments. (Abstr.)

754 Mallory Boush, G., Matsumura, F. INSECTICIDAL DEGRADATION BY Pseudomonas melophthora, THE BACTERIAL SYMBIOTE OF THE APPLE MAGGOT. J. econ. Ent. 60, 4 (1967) 918-920.

P. melophthora (Allen and Riker), an obligate extracellular bacterial symbiote of the apple magot, Rhagoletis pomonella (Walsh), has demonstrable degradation activities against all six insecticides tested (dichlorovos, diazinon, parathion, DFP (diisopropyl phosphorofluoridate), dieldrin, and carbaryl), belonging to three major groups (chlorinated hydrocarbons, organophosphates, and carbamates). The methods employed to analyse the degradation pattern of P. melophthora against naphthalene ring ^{3}H-labelled carbaryl and diethyl ^{3}H-labelled parathion were essentially those of Ref. 835. Diethyl ^{14}C-labelled diazinon, diethyl ^{14}C-labelled dichlorvos, and diisopropyl ^{14}C-labelled DFP (diisopropyl phosphorofluoridate) were handled as with parathion. ^{14}C-dieldrin was used. This is the first demonstration of insecticidal degradation by an insect microbial symbiote. However, the significance of this unique property as a possible protecting mechanism of the host insect is unknown.

755 Martinenghi, C., Riccardi, A., Baraldi, C. OSSERVAZIONI SPERIMENTALI SULLA MARACUTRA IN VITRO DELLE CELLULE EMATICHE CON DIISOPROPILFLUOROFOSFATO (DFP^{32}). (Experimental data on in vitro labelling of blood cells with diisopropylfluorophosphate (DF^{32}P).) Acta isotopica 5, 1 (1965) 91-100. (In Italian, with English, French, and German summaries)

The effects of temperature and concentration of DF^{32}P on in vitro labelling of erythrocytes and granulocytes were studied. The radioactive concentration of the blood cells could be shown to increase with increasing plasma concentration, tending asymptotically to a max., whereas the

incubation temperature did not affect labelling of the cells. Analysis of the results suggests that the tracer may be contained in the cells in at least two different states – one more stable, and the other labile. This might account for the elution phenomenon observed in vivo for erythrocytes. (Based on auth.)

756 Martinenghi, C., Riccardi, A., Baraldi, C. CONTRIBUTO ALLO STUDIO DELLA MARCATURA IN VIVO CON ^{32} DFP DEGLI ERITROCITI NEL CONIGLIO. (In vivo labelling of red blood cells with DF ^{32}P in the rabbit.) Minerva nucl. 9 (1965) 332-335. (In Italian, with English and French summaries)

The labelling of erythrocytes with DF ^{32}P was investigated in rabbits by administering 20 μCi/kg of body weight intravenously and by measuring the radioactivity of the plasma and the red blood cells for 17 d. It was found that the curve expressing the concentration of the radioactivity in the red blood cells shows a peak at 2 h after the injection of the tracer and then declines following a couple of exponentials. The hypothesis is suggested that the 1st term, with a steep negative dip, is due to a phenomenon of elution of a part of the tracer which is less firmly bound to the endocellular complexes, whereas the second, with a less steep negative dip, expresses the survival of the erythrocytes. (Auth.)

757 Matsumura, F., Boush, G.M. MALATHION DEGRADATION BY Trichoderma viride AND A Pseudomonas SPECIES. Science, N.Y. 153 (1966) 1278-1280.

To study the total ability of the soil samples used to break down malathion, a 10 g portion of each soil sample was first incubated for 24 h at 30°C with 20 mg of ^{14}C-malathion (labelled at 1,2-succinyl carbon moiety) that had been previously applied to the inner surface of the sample flasks as thin films, with the aid of acetone as a carrier. Malathion was found to be metabolised quickly by a soil fungus, T. viride, and a bacterium, Pseudomonas sp., which were originally found in soils from northern Ohio that had been sprayed heavily with insecticides. Results of a survey of the breakdown capabilities of 16 variants of T. viride revealed that certain colonies from this species had a very marked ability to break down malathion through the action of a carboxylesterase(s). The enzymes can be made soluble by preparing the acetone powder suspension.

758 McDuffie, W.C. USE OF RADIOISOTOPES IN THE DETECTION OF RESIDUES IN MEAT AND MILK. p.3-17 of "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, Austria, 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria), 1966, 118p.

^{32}P was used in residue analyses of labelled ronnel, coumaphos (Co-Ral), ruelene, dioxathion (Delnav), Ciodrin ®, and Shell Compound 4072. Various studies are reviewed and relevant references cited.

759 Mengle, D.C., Lewallen, L.L. BIOCHEMICAL-RADIOLOGICAL DETERMINATIONS OF PARATHION RESISTANCE IN Aedes nigromaculis. J. econ. Ent. 59 (1966) 743-744.

The fate of ^{32}P-parathion was studied in resistant and susceptible strains of A. nigromaculis. To approximate the concentration used in the field for mosquito control, 4th-instar larvae were treated at the 24-h LC 90 of the susceptible strain (0.025 ppm). Mosquitoes were removed and tested at intervals of ¼, ½, 1, 2, 4, 6, and 24 h, and assayed for parathion and hydrolysis products. The water solubles increased more rapidly in the resistant larvae, indicating that there was more rapid breakdown of the insecticide in that population. After initially absorbing nearly the same amount of insecticide as the susceptible larvae the resistant larvae contain a lower level of organic solubles. The chromatographic determination of water-soluble metabolites indicates that both the susceptible and resistant strains convert parathion to a water extractable material (0.72 and 0.68) whose R_f is similar to that of paraoxon (0.70). The R_f value 0.58 indicates the presence of a water-soluble compound present in resistant larvae treated with large quantities of paraoxon, a compound not present in the susceptible larvae following similar treatment. Also, treatment with a massive dose of parathion, while producing paraoxon in vivo in both strains, did not result in formation of detectable amounts of a material with R_f of 0.58.

760 Michailova, O.S. METABOLISM OF TRICHLOROMETAPHOS 3 IN ANIMALS. Khim. sel'sk. Khoz. 4, 8 (1966) 619-622. (In Russian)

To study the rate of cutaneous penetration of the insecticide trichlorometaphos 3 (I), 0.2 ml of a 10% aqueous solution of ^{32}P- and ^{35}S-labelled I were applied on the skin of mice, which were sacrificed at various intervals; the skins were subjected to radiometric analysis. The amount of I in the skin dropped within 1 d to 1/2, and within 14 d to 1/10 of the original. In rabbits, the cutaneous application of 200 mg I/kg body weight (as an aqueous emulsion) led to its appearance in the blood within 15 min, with peaks on the 2nd and 3rd day, and a total duration of 10 d. In the organs and tissues of the experimental rabbits the max. I content was obtained on the 3rd day. Cutaneous application of 1.5 l of a 1.5% aqueous solution of I to a cow resulted in its appearance in the blood within 1 h, with a max. on the 2nd day, when the blood cholinesterase activity was least. I was detected in all organs and tissues of this cow (sacrificed on the 3rd day), high concentrations being recorded in lungs, brain, bones, liver, kidneys, and the foetus. Peroral administration of 100 mg I/kg body weight to rabbits, caused its appearance in organs and tissues within 30 min, with a max. concentration in the lungs and liver, with a continuous increase up to 3 h, followed by a slow decrease to zero within 40 d. Peroral administration of 20 mg I/kg body weight to a calf, which was sacrificed on the 2nd day, resulted in a high radioactivity of the lungs, spinal cord, bones, liver, and kidneys, and a minimal amount in the spleen and muscles. A study of the excretion of cutaneously applied I via urine, faeces, and milk revealed that in rabbits I is intensively eliminated in the urine for 4 d, and with the faeces for 5-6 d, reaching zero within 20-25 d, while in a calf the urinary excretion lasted 11 d, and the faecal excretion 14 d, with peaks on the 1st day. I and its metabolites were secreted in milk over a period of 10 d. (CA 65: 1966, 19244)

761 Miller, C. W., Zuckerman, B. M., Charig, A. J. WATER TRANSLOCATION OF DIAZINON-^{14}C AND PARATHION-^{35}S OFF A MODEL CRANBERRY BOG AND SUBSEQUENT OCCURRENCE IN FISH AND MUSSELS. Trans. Am. Fish. Soc. 95, 4 (1966) 345-349.

One day after application of diazinon-^{14}C and parathion-^{35}S to a model cranberry bog, these chemicals were transported off the bog in water used in a simulated frost protection flood. Fish (Fundulus heteroclitus) and fresh-water mussels (Elliptio complanatus) were exposed to these contaminated waters and analysed periodically. The majority of the chemicals disappeared from the water after 144 h. During this time, no labelled metabolites of diazinon were detected; however, three labelled parathion degradation products were encountered. The fish and the mussels accumulated both pesticides. (CA 66: 1967, 27980u)

762 Miyamoto, J., Sato, Y. DETERMINATION OF INSECTICIDE RESIDUE IN ANIMAL AND PLANT TISSUES. II. METABOLIC FATE OF SUMITHION IN RICE PLANTS AT THE PREHEADING STAGE AND ITS RESIDUE IN HARVESTED GRAINS. Botyu-kagaku 30, 2 (1965) 45-49.

Metabolic fate was followed in rice plants after the plants were sprayed with ^{32}P-labelled Sumithion (O,O-di-Me S-[1,2-bis(ethoxycarbonyl)ethyl] dithiophosphate) at the preheading stage. After penetration into the tissues, Sumithion was decomposed rather rapidly into demethylsumithion, dimethylphosphorothioic acid, and phosphorothioic acid as determined by thin-layer chromatography. Presence of the O analogue of Sumioxon (O,O-di-Me O-(3-methyl-4-nitrophenyl) phosphate) was also demonstrated. Residual amounts of Sumithion and its metabolites in the rice grains of several varieties of rice were determined after its application under various conditions. Sumithion and Sumioxon were hardly detectable, while 1 ppm or less of degradation products such as dimethylphosphorothioic acid, phosphorothioic acid, and free p-nitrocresol were identified. (CA)

763 Morikawa, O., Saito, T. DEGRADATIONS OF VAMIDOTHION AND DIMETHOATE IN PLANTS, INSECTS, AND MAMMALS. Botyu-kagaku 31, 3 (1966) 130-135. (In English)

The metabolism of dimethoate-^{32}P (I) and vamidothion-^{32}P (II) in insects, plants, and mammals was studied in vivo and in vitro. Several metabolic products of II* were detected within insects, plants, and mouse urine by paper chromatography. Demethylvamidothion was detected only in plants. The optimum pH for the degradation of I and II was ~8 for the rat liver homogenate and 7 - 7.4 for the insect homogenate. I and II were hydrolysed greatly by the fat body homogenate and slightly by the total gut and muscle homogenates of the American cockroach. The hydrolysis of the S-C bond of I and II was specific to the rat liver homogenate. (CA 68: 1968, 28719 u)

* Vamidothion = O,O-dimethyl S-2-(1-methylcarbamoylethylthio)ethyl phosphorothioate.

764 Muelder, W.W., Wass, M.N. A SEMIMICRO PREPARATION OF O,O-DIETHYL O-(3,5,6-TRICHLORO-2-PYRIDYL-2,6-C^{14}) PHOSPHOROTHIOATE. J. agric. Fd Chem. 15, 3 (1967) 508-511.

Dursban insecticide (Dow Chemical Co.) contains O, O-diethyl O-(3,5,6-trichloro-2-pyridyl-2,6-^{14}C) phosphorothioate. Using a 6-step synthesis, 40 mCi of ^{14}C-KCN were converted to 7.5 mCi of tracer having a specific activity of 1.5 mCi/mM, via glutaronitrile-1,5-^{14}C→glutarimide-2,6-^{14}C →2,3,6-trichloropyridine-2,6-^{14}C→3,6-dichloro-2-pyridinol-2,6-^{14}C→3,5,6-trichloro-2-pyridinol-2,6-^{14}C. It assayed better than 99.5% by thin-layer chromatography. The yield is one half of the expected amount based on results from pilot experiments. With the 1.7 mCi of recovered precursor, 3,5,6-trichloro-2-pyridinol-2,6-^{14}C, a radiochemical yield of 23% was obtained.

765 Nakatsugawa, T., Tolman, N.M., Dahm, P.A. DEGRADATION OF P^{32}-AND S^{35}-LABELED PARATHION IN VIVO. Bull. ent. Soc. Am. 12 (1966) 264. Abstr. 57, at "Portland Meeting. Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

Degradation of ^{32}P- and ^{35}S-labelled parathion was studied with male rats. SKF 525-A delayed urinary excretion of diethyl phosphorothioic acid indicating the significance of liver microsomal enzymes in degradation of parathion. Detached sulphur appeared in urine as inorganic sulphate later than diethyl phosphorthioic acid. (Abstr.)

766 Nakatsugawa, T., Dahm, P.A. MICROSOMAL METABOLISM OF PARATHION. Biochem. Pharmac. 16, 1 (1967) 25-38.

Studies of the microsomal activation of parathion-^{35}S showed that a ^{35}S metabolite was bound onto microsomes, probably as the result of desulfuration in the activation reaction. Further work indicated that rabbit liver microsomes also degraded parathion by splitting at the aryl phosphate bond. Both activation and degradation by microsomes required NADPH and O, and were inhibited by SKF 525-A and insecticide synergists. The system was specific to parathion and did not degrade paraoxon. The degradation was also demonstrated with microsomes from rat liver and cockroach fat body and a model system (EDTA, Fe^{2+}, and ascorbate). (CA 66:1967, 75229c)

767 Nakatsugawa, T., Tolman, N.M., Dahm, P.A. METABOLISM OF ^{35}S-PARATHION IN INSECTS. Bull. ent. Soc. Am. 13, 3 (1967) 191. Abstr. 82, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Diethyl phosphorothioic acid (DEPTA) and SO_4 were generally the major ^{35}S-metabolites of parathion in vivo in Periplaneta americana and Musca domestica. Topically applied sesamex suppressed the production of both metabolites, indicating the participation of oxidative enzymes. In vitro production of DEPTA was also examined. (Abstr.)

768 Neal, R.A. STUDIES ON THE METABOLISM OF DIETHYL 4-NITROPHENYL PHOSPHOROTHIONATE (PARATHION) IN VITRO. Biochem. J. 103, 1 (1967) 183-191.

The metabolism of the phosphorothionate parathion in vitro was examined by using [^{32}P]parathion and microsomes isolated from the livers of various animals species.* The major metabolic products of parathion in this system in vitro were identified as diethyl 4-nitrophenyl phosphate (paraoxon), diethyl hydrogen phosphate, diethyl hydrogen phosphorothionate and p-nitrophenol. The reaction leading to the formation of diethyl hydrogen phosphorothionate and p-nitrophenol requires the same cofactors (NADPH and oxygen) required for metabolism of parathion to its active anti-acetylcholinesterase paraoxon. The enzyme activity towards parathion per unit weight of liver is increased some 65-130% by pretreatment of male rats with phenobarbital and 3,4-benzopyrene. The metabolism of parathion is inhibited by incubation in a nitrogen atmosphere and in an atmosphere containing CO. Pure O_2 is also inhibitory. These results are discussed in terms of a deficiency of oxygen for maximal activity as well as the lability of some component of the system to oxidation. (Auth.)

*rats, mice and guinea pigs.

769 Pietri-Tonelli, P. de, Bazzi, B., Santi, R. ROGOR (DIMETHOATE) RESIDUES IN FOOD CROPS. Residue Rev. 11 (1965) 60-95.

This paper presents first a review of methods developed by several workers for the qualitative detection and quantitative estimation of Rogor and of its metabolites in treated plants. Several physico-chemical procedures are thus reported based on colorimetry, column, paper and thin-layer chromatography, paper electrophoresis, gas chromatography, and radiometry. Then a brief account is given of bioassay techniques used for the same purpose and applied directly on homogenized plant tissues or on the extracts. Autoradiographic procedures are also mentioned which were adapted for the investigation of the pattern of distribution of ^{32}P-Rogor and of its radioactive metabolites in macrosections of plant organs. The residue degradation and persistence curves of Rogor and its metabolic fate in plants are then considered and data are reported regarding several treated fruit crops (cherries, apricots, peaches, olives, tangerines, grapefruit, apples, and grapes) and vegetable crops (sugar beets, cotton, potatoes, snap beans, and carrots). The findings support the evidence that the concentration of Rogor and of its P=O metabolite in plant organs decreases at a variable rate depending, among other factors, upon the botanical species and variety, rate of growth, morphological structure, and location of the organs in the plant and on the date of treatment. Finally a summary is presented of harvest residues determined by various methods on 35 fruit and vegetable crops treated with Rogor in different ways and under different conditions. (Auth. summary.)

770 Ralls, J.W., Gilmore, D.R., Cortes, A. FATE OF RADIOACTIVE O,O-DIETHYL O-(2-ISOPROPYL-4-METHYLPYRIMIDIN-6-YL) PHOSPHOROTHIOATE ON FIELD-GROWN EXPERIMENTAL CROPS. J. agric. Fd Chem. 14, 4 (1966) 387-392.

Plants* grown in a fenced, controlled, and monitored agricultural plot were sprayed with Diazinon labelled with ^{35}S. The residue level of diazinon fell rapidly below tolerance levels (0.75 ppm) on all crops studied. There was no evidence of predicted S-containing metabolites at levels above 0.1 ppm on crops treated at recommended dosage. The only metabolite identified from the field samples was oxo-diazinon at an estimated level of 0.01-0.05 ppm. Radioactive 2-isopropyl-4-methylpyrimidin-6-ol was isolated from tomatoes 5 d after spraying with pyrimidine ring labelled diazinon-^{14}C. The present evidence suggests that diazinon is oxidized rapidly to oxo-diazinon which is, in turn, hydrolysed to 2-isopropyl-4-methylpyrimidin-6-ol. The latter compound is metabolised, in part, to carbon dioxide by a pathway which does not appear to involve acetoacetic acid (or its amide). (Auth.)

*tomato, snap beans, spinach.

771 Ramachandran, B.V. DISTRIBUTION OF DF^{32}P IN MOUSE ORGANS. I. THE EFFECT OF ROUTE OF ADMINISTRATION ON INCORPORATION AND TOXICITY. Biochem. Pharmac. 15, 2 (1966) 169-175.

The LD 50 of diisopropyl phosphorofluoridate (DFP) for mice by the intraperitoneal route was 6.8 mg/kg, while that by the subcutaneous or intravenous route was much lower (3.8 and 3.4 mg/kg, respectively). When DF^{32}P is injected into mice or rats by the intraperitoneal route, there is a higher uptake of radioactivity in the liver, with a corresponding reduced incorporation in other organs than when the administration is by the subcutaneous or the intravenous routes. Death occurs when the concentration of DF^{32}P reaches a certain critical value in some organs including the brain, whatever the route employed. A large part of the detoxication of DFP which is known to take place in the liver is thus due to its absorption by the liver esterases whose inhibition obviously does not contribute materially to the overall toxicity. (CA 64: 1966, 14888g)

772 Reesor, J.B., Perry, B.J., Sherlock, E. THE SYNTHESIS OF HIGHLY RADIOACTIVE ISOPROPYL METHYLPHOSPHONOFLUORIDATE (SARIN) CONTAINING P^{32} AS TRACER ELEMENT. Can. J. Chem. 38 (1960) 1416-1427.

Procedures are described for the safe processing of multicurie quantities of irradiated red phosphorus into isopropyl methylphosphonofluoridate (sarin) having a specific activity of 250-300 mCi/g. The use of costly remote-handling equipment is avoided by suitable choice of synthetic route and apparatus design. (Auth.)

773 Reller, J. CHOLINESTERASE-BESTIMMUNG IN ENDPLATTEN MIT RADIOAKTIVEM DIISOPROPYL-FLUOROPHOSPHAT. (The evaluation of cholinesterase in endplates by means of radioactive diisopropylfluorophosphate.) Thesis, Eidgenössische Technische Hochschule, Zürich (Switzerland). Zürich 1966, 56p. (In German)

The uptake of ^{14}C- and ^{32}P-DFP by end plates in the mouse diaphragm was determined by densitometric evaluation of contact autoradiographs. Treatment with ^{14}C-DFP gave autoradiographs of better resolution which allowed individual end plates or groups of end plates to be distinguished on autoradiographs instead of the end-plates band appearing as a diffusely blackened zone when the diaphragms were incubated in ^{32}P-DFP. DFP binding and cholinesterase activity were found to correspond closely. Pre-treatment with physostigmine (10^{-5} M) gave negative autoradiographs. The amount of DFP bound and the cholinesterase activity were found to correspond closely. The end plates proved saturated at a concentration of 10^{-5} M; a similar DFP concentration decreased the cholinesterase activity to <5% of the original value. The approx. number of 2.2×10^7 DFP molecules required for the saturation of an end plate coincides with the number of active centres of cholinesterase. The amount of DFP bound by degenerating end plates was studied in mice killed at various intervals after phrenectomy. Qualitatively, the changes visible on autoradiographs agreed with the histochemical changes observed.

774 Reynolds, H.T., Metcalf, R.L., Fukuto, T.R. SYSTEMATIC INSECTICIDAL ACTION OF O-METHYL O-PARA-METHYLTHIOPHENYL METHYLPHOSPHONOTHIONATE AND RELATED COMPOUNDS. J. econ. Ent. 59, 2 (1966) 293-299.

32 O,O-dialkylphosphates and phosphorothioates and the comparable O-alkyl alkylphosphonates and alkylphosphonothionates, all incorporating the p-methylthiophenyl ester or its sulfoxide or sulfone oxidation products, were investigated in the laboratory and four of the best of these in the field of systemic action in cotton plants. The relation of structure to systemic activity was analysed and O-methyl O-p-methylthiophenyl methylphosphonothionate (XI) was somewhat the best of the series studied. Metabolism within the cotton-plant environment, studied by ^{32}P labelling, followed the typical pattern of oxidation to sulfoxide and then to sulfone together with oxidation of P = S to P = O. This fact re-emphasises the importance of the methylthio-group in providing a delayed period of toxicity during and following absorption and translocation. Typically, the systemic readily translocated to the leaves with the highest amounts entering the rapidly growing upper leaves. Much smaller amounts entered the bracts but not the fruiting portion of the developing squares. Field results showed promise with the best compound within the series for seed treatment or in-furrow granulated treatments applied at time of planting. Granulated soil treatments to large plants, however, were inferior to other types of systemic compounds with a much higher water solubility. (Auth.)

775 Ridgway, R.L., Lindquist, D.A. SYSTEMIC ACTIVITY OF SHELL SD-9129 IN COTTON PLANTS. J. econ. Ent. 59, 4 (1966) 961-964.

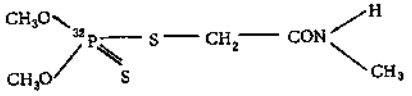
^{32}P-labelled SD-9129 was used. It was 98% or more cis isomer. (Cf. Bull and Lindquist 1966, ref. 700). The systemic activity of Shell SD-9129 (dimethyl phosphate ester with 3-hydroxy-N-methyl-cis-crotonamide) in cotton plants was studied by bioassay and radioassay. The insects and a mite used for bioassay were the cotton aphid, Aphis gossypii Glover; the boll weevil, Anthonomus grandis Boheman; and the carmine spider mite, Tetranychus telarius (L.). After application to lower leaves, little or no SD-9129 was found in untreated leaves above treated lower leaves. However, relatively large amounts were found in nectar of the cotton plant after the toxicant was applied to the stem. SD-9129 was not particularly effective as a systemic insecticide when it was applied to cotton seed or to the soil.

776 Ridgway, R.L., Walker, H.J., Hanna, R.L., Owen, W.L. FERTILIZERS IMPREGNATED WITH SYSTEMIC INSECTICIDES FOR CONTROL OF COTTON INSECTS. J. econ. Ent. 60, 2 (1967) 592-594.

Greenhouse and field tests were conducted to compare the effectiveness against cotton insects of granules and fertilizer impregnated with phorate, disulfoton, and American Cyanamid CL-47031 (cyclic ethylene (diethoxphosphinyl)dithioimidocarbonate) and applied to cotton plants. ^{32}P-disulfoton was used. Bioassays and radioassays of treated plants indicated that the levels of uptake from both formulations were similar after in-furrow and sidedress applications. Phorate and disulfoton were stable on I grade of fertilizer for more than three months.

777 Roderbourg, J., Vervier, R. CONTROLE DE L'EXTRACTION DE RESIDUS DE DIMETHOATE SUR EPINARDS AU MOYEN DE DIMETHOATE MARQUE AU P 32. (Developing extraction methods for dimethoate residues in spinach using ^{32}P-dimethoate.) Meded. LandbHoogesch. OpzoekStns Gent 30, 3 (1965) 1873-1878. (In French, with French, Flemish, English and German summaries)

Les auteurs étudient différents modes d'extractions et de purification d'extraits végétaux (épinard) contenant du diméthoate au moyen de diméthoate au ^{32}P. Le diméthoate marqué possédait une activité spécifique de 10 mCi/mg, avec une formule comme suit:



Le diméthoate a été utilisé sans porteur afin d'obtenir un rendement de comptage de ses radiations assez élevé tout en maintenant des concentrations de produits aussi faibles que celles qui sont rencontrées dans la pratique (~ mg de diméthoate/g d'épinards). A chaque lot d'épinards soumis à l'analyse on a ajouté 5,7 mg de diméthoate radioactif (57,2 µg/g d'épinards). Les auteurs démontrent les avantages de l'emploi de tels éléments radioactifs pour la mise au point de méthode appropriée d'extraction de résidu.

778 Roderbourg, J., Vervier, R. CONTROLE DE L'EXTRACTION DE RESIDUS DE DIMETHOATE SUR EPINARDS AU MOYEN DE DIMETHOATE MARQUE AU P 32. AED-Conf-067-1, Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany). 1965, 7p.

La méthode d'extraction décrite a été étudiée au moyen de diméthoate marqué au ^{32}P que l'on ajoutait à des extractifs d'épinards nontraités de manière à chiffrer le rendement de cette opération et le taux de récupération du diméthoate. Le ^{32}P-diméthoate possédait une activité spécifique de 10 mc/mg. Il parait que la méthode d'extraction des auteurs s'adapte parfaitement au processus analytique employé et a permis de déceler des doses de diméthoate inférieures au 0,1 ppm.

779 Roderbourg, J., Vervier, R. DEVELOPING EXTRACTION METHODS FOR DIMETHOATE RESIDUES IN SPINACH USING RADIOACTIVE DIMETHOATE. Paper presented at the "17th International Symposium of Crop Protection. 1965". (Location?)

780 Roulston, W.J., Schuntner, C.A., Schnitzerling, H.J. METABOLISM OF COUMAPHOS IN LARVAE OF THE CATTLE TICK Boophilus microplus. Aust. J. biol. Sci. 19, 4 (1966) 619-633.

[^{32}P]Coumaphos, a phosphorothionate, was rapidly absorbed and metabolised by cattle tick larvae dipped in aqueous suspensions of the acaricide. One metabolite was shown by chromatographic, spectroscopic, and cholinesterase inhibition evidence to be the oxygen analogue, a more potent in vitro cholinesterase inhibitor than the parent compound. Other water soluble metabolites were only tentatively identified. Sublethal doses were metabolised mainly to water-soluble materials and a small quantity of oxygen analogue whereas lethal doses, producing complete mortality in 2-3 h, yielded almost equal amounts of the oxygen analogue and water-soluble materials. In vivo inhibition of cholinesterase in treated larvae was dose-dependent and preceded death. (Auth. summary)

781 Sato, Y., Miyamoto, J. AN ASPECT CONCERNING THE MOVEMENT OF DIMETHOATE FROM ITS GRANULAR FORMATION IN SOIL. Nayaku Seisan Gijutsu 16 (1967) 23-28.

^{32}P-labelled dimethoate (I) -coated granules consisting of labelled I 5, poly(vinyl alcohol)2, and clay 93% were applied to sandy loam soil at a depth of 1 cm. In H_2O-saturated soil, I slowly moved horizontally and vertically. When H_2O was added to the soil surface, I moved downward with H_2O, the rate increasing with the amount of H_2O while the horizontal movement was slower. More than 80% of applied I was found undecomposed 7 d after application. (CA 66: 1967, 11489j)

782 Schuntner, C.A., Thompson, P.G. DETECTION AND ESTIMATION OF [^{14}C] DIAZINON IN VIVO BY COUNTERCURRENT DISTRIBUTION AND INHIBITION ASSAY. Biochim. biophys. Acta 115, 1 (1966) 225-7.

An estimate of diazoxon (diethyl 2-isopropyl-6-methyl-4-pyrimidinyl phosphate) was attempted in larvae of the cattle tick, Boophilus microplus, treated with [ethoxy-^{14}C] diazinon. Although satis-

factory resolution of the authentic nonradioactive compound could be obtained on paper- and gas-chromatograms, results with extracts of [^{14}C] diazinon-treated larvae were not quantitative nor readily reproduced. A countercurrent distribution system was devised to resolve mixtures of authentic diazoxon, diazinon and related water-soluble compounds, and to allow liquid scintillation counting of the tube contents with minimal quenching. (A better assay of diazoxon after countercurrent distribution is obtainable by the esterase inhibition method.) Larval extracts could thus be used directly in the lower phase without solvent evaporation. A radioactive peak in countercurrent distributions of extracts of [^{14}C] diazinon-treated larvae corresponded exactly with authentic diazoxon, and also had esterase inhibition properties which, when converted to equivalent diazoxon, gave a reasonable fit to the radioactivity curves.

783 Schuntner, C.A., Schnitzerling, H.J. SEPARATION OF ^{32}P-LABELED DIOXATHION COMPONENTS ON A SILICIC ACID COLUMN. J. Chromat. 27, 1 (1967) 272-275.

A mixture of the cis and trans isomers of p-dioxane-2,3-dithiol S,S-bis (O,O-di-Et phosphorodithiotate), the dioxene derivative p-dioxene-2-thiol S-(O, O-di-Et phosphorodithioate), and several minor insecticidally active compounds was separated on a 105 mm × 6 mm glass column packed with 1 g solvent-washed and activated silicic acid, partly deactivated with 15% vol/wt H_2O, lightly ground to a slurry with 10% C_6H_6 in n-hexane. A gradient of 10% C_6H_6 in n-hexane was used as eluant for the 12 1-ml fractions, 75% C_6H_6 in n-hexane for fractions 13-21, and 100% C_6H_6 for the remainder. The mixture components were identified by infrared. (CA 67: 1967, 10655q)

784 Schwarz, H., Dedek, W. DAS VERHALTEN VON RADIOAKTIV MARKIERTEM TRICHLORPHON NACH POUR-ON APPLIKATION (AUFGIESSVERFAHREN) ZUR DASSELLARVENBEKÄMPFUNG BEIM RIND. (The behaviour of radioactively labelled trichlorphon following pour-on application for combating Hypoderma larvae in cattle.) Mh. VetMed. 20 (1965) 958-960. (In German)

The percutaneous resorption of the active substance was studied on two test cows using different doses, and the concentration of active substance in the blood and milk were determined. ^{32}P-trichlorphon was used. Quantities as low as 0.01 ppm could still be detected with certainty. The concentration of active substance in the blood necessary for killing the parasites are discussed, in connection with available experimental data.

785 Schwarz, H., Dedek, W. UNTERSUCHUNGEN ZUM NACHWEIS VON ^{32}P-MARKIERTEM TRICHLORPHON IM FLEISCH BEIM SCHWEIN. (Studies on the detection of ^{32}P-labelled trichlorphon in pork.) Zentbl. VetMed. 13b (1966) 489-494. (In German, with English, French and Spanish summaries)

^{32}P-trichlorphon was injected subcutaneously to two pigs at 25 mg/kg body weight. The trichlorphon had a high specific activity and was administered in the form of Bubulin, which contains 500 g trichlorphon, 5 g 2-PAM* and 1.5 g atropine sulphate, dissolved in polyglycol ad 1000 ml, as manufactured by VEB Serumwerk Bernburg. The trichlorphon level in pork was determined by extraction with chloroform. The level in the meat was always lower than in blood; 2 h after injection 5 ppm were found in the meat. Already within 6-7 h the level had dropped to one tenth.

*puridine-2-aldoxine methiodide.

786 Schwarz, H., Dedek, W. DAS VERHALTEN VON RADIOAKTIV MARKIERTEM TRICHLORPHON NACH RÜCKENWÄSCHE ZUR DASSELLARVENBEKÄMPFUNG BEIM RIND. (The fate of radioactively-labelled trichlorphon after dorsal scrubbing of cattle against botfly lavae.) Mh.VetMed. 21 (1966) 945-947. (In German, with Russian and English summaries)

500 ml of an aqueous solution (2%) of ^{32}P-trichlorphon were applied to cattle by dorsal scrubbing. Residues amounted to max.concentrations of 0.2 ppm in the blood and 0.15 ppm in milk. The use of aqueous trichlorphon for controlling botfly larvae in cattle is discussed. No objections to the use of such milk for human consumption have so far been voiced in international recommendations.

787 Schwarz, H., Dedek, W. THE BEHAVIOUR OF ^{32}P-LABELED ORGANOPHOSPHORIC INSECTICIDES AFTER INTRACISTERNAL ADMINISTRATION IN CATTLE. RESORPTION OF BIOLOGICALLY ACTIVE SUBSTANCES FROM THE UDDER OF CATTLE. I. TRICHLORFON. Arch. exp. VetMed. 21, 4 (1967) 1031-1035. (In German)

Trichlorfon administered intracisternally to milk cows is absorbed unchanged into the blood from the udder, appearing in the blood and milk within a few minutes after infusion. Only traces of unchanged trichlorfon remain in the milk 6-7 h after injection, the major portion being metabolised in the udder. (CA 68:1968, 86364k)

788 Shishido, T., Fukami, J. STUDIES ON THE SELECTIVE TOXICITIES OF ORGANIC PHOSPHORUS INSECTICIDES. II. THE DEGRADATION OF ETHYL PARATHION, METHYL PARATHION, METHYL PARAOXON AND SUMITHION IN MAMMAL, INSECT AND PLANT. Botyu-kagaku 28, 3 (1963) 69-76. (Japanese summary)

The in vitro degradation of several phosphorus insecticides (labelled with ^{32}P) by homogenates of rat liver, larvae of Chilo suppressalis or adults of Periplaneta americana (L.), and plant tissue (cauliflower) was investigated. The supernatant fraction of the rat-liver homogenate was more effective in degrading methyl-parathion, methyl-paraoxon [dimethyl p-nitrophenyl phosphate] and fenitrothion (Sumithion) to water-extractable metabolites than were the mitochondria and washed microsome fractions, the latter two being similar in effect. The supernatant fraction degraded parathion to a very small extent as compared with methyl parathion and fenitrothion. In the insect homogenates, degradation activity was similar in the supernatant and in the washed microsome and mitochondria fractions. No degradation of methyl parathion or methyl paraoxon was evident in the plant homogenates. The water-extractable metabolites were subjected to ion-exchange chromatography, and five were found. Four of them were identified as phosphoric or phosphorothioic, dialkyl phosphorothioic, desalkyl phosphorothioic and desalkyl phosphoric acid. With the supernatant of the rat-liver homogenate, the principal metabolites of methyl parathion, methyl paraoxon and fenitrothion were desmethyl-parathion (O-methyl O-p-nitrophenyl phosphorothioic acid), desmethyl-paraoxon (methyl p-nitrophenyl phosphoric acid) and desmethyl-fenitrothion (O-methyl O-3-methyl-4-nitrophenyl phosphorothioic acid), respectively. In the case of parathion, the production of desethyl-parathion [O-ethyl O-p-nitrophenyl phosphorothioic acid] was very slight. Relatively small amounts of these metabolites were produced by the supernatant of the insect homogenates. (RAE-A 55: 1967, ref.197)

789 Smith, G.N. BASIC STUDIES ON DURSBAN INSECTICIDE. Down to Earth 22, 2 (1966) 3-7.

Approximately 70% of ^{36}Cl- or ^{14}C-labelled Dursban (O-O-di-Et O-3,5,6-trichloro-2-pyridyl phosphorothioate) (I) in a Me_2CO solution applied to Fe, Pb, Al, and stainless steel sheets was lost by evaporation in 24 h when held in a control chamber (45-50% humidity, day temperature 92°F for 16 h., night temperature 76°F for 8 h). In the case of Cu sheets, the metal reacted with I, while with painted surfaces I was carried into the paint layer. With Whatman No.1 filter paper, 83% was lost in 3 d, but with a formulation containing surfactants, 52% remained after 12 d. I tended to exhibit a high persistence in situations where volatility was not a factor, i.e., soils. I as a dry powder was very stable to u.v. light. In the presence of water, hydrolysis was appreciable and the resulting 3,5,6-trichloropyridin-2-ol was very susceptible to u.v. light decomposition. Approximately 80% of I applied to a plant was lost by evaporation, ~20% remained in the treated area and was degraded and 1-2% was unchanged. When plants were grown in a solution containing 50 ppm I, 60% of the compound plated out on the roots, which metabolised it translocating the decomposition products to other parts of the plant. In the rat, labelled I was rapidly metabolised and detoxified products were rapidly eliminated via the urine and faeces except for small amounts which accumulated in the fat and were slowly eliminated once medication was discontinued. Fish also metabolised labelled I rapidly, the majority of the radioactivity being found in the viscera with small amounts in the skin and meat. The varying anticholinesterase activity of different lots of I was ascribed to the presence of small amounts of its O-analogue, which was a potent cholinesterase inhibitor. A I sample purified by thin-layer chromatography gave no cholinesterase inhibition. (CA 65: 1967, 17629c)

790 Smith, G.N., Watson, B.S., Fischer, F.S. THE METABOLISM OF [^{14}C] O, O-DIETHYL O-(3,5,6-TRICHLORO-2-PYRIDYL) PHOSPHOROTHIOATE (DURSBAN) IN FISH. J. econ. Ent. 59, 6 (1966) 1464-1475.

The new Dursban® insecticide is effective in controlling mosquitoes. The active ingredient of this insecticide is O, O-diethyl O-(3,5,6-trichloro-2-pyridyl) phosphorothioate. In spraying Dursban to control mosquitoes, the chemical will come in contact with the fish, plants, and soil in the environment. In investigations with [^{14}C] labelled insecticide, it was found that the Dursban is rapidly absorbed from the water by plants and soil particles, but very slowly metabolised. Fish absorb the compound at a much slower rate, but rapidly metabolise it. The detoxified products are then eliminated into the water. Under natural conditions the majority of the Dursban will be absorbed by the plants and soil particles thus limiting the amount which can be taken up by the fish. (Auth.)

791 Smith, G.N., Watson, B.S., Fischer, F.S. DURSBAN INSECTICIDE. UPTAKE AND TRANSLOCATION OF O,O-DIETHYL O-3,4,6-TRICHLORO-2-PYRIDYL PHOSPHOROTHIOATE-^{36}Cl AND O,O-DIETHYL O-3,5,6-TRICHLORO-2-PYRIDYL PHOSPHOROTHIOATE-^{14}C BY BEANS AND CORN. J. agric. Fd Chem. 15, 1 (1967) 127-131.

The uptake and translocation of ^{36}Cl-labelled Dursban and ^{14}C-labelled Dursban by leaves and corn plants were studied. Both root and leaf absorption were insignificant. Only 1-2% of the radioactivity was translocated into the plant. These were largely breakdown products such as the 3,5,6-trichloro-2-pyridinol. In foliar spray treatment, most of the radioactivity was lost from the leaf by volatilization. Since absorption and translocation of Dursban or its decomposition products were insignificant, the only place a significant amount of radioactivity could be found was on the treated area. (CA 66:1967, 54495w)

792 Smith, G.N., Watson, B.S., Fischer, F.S. DURSBAN INSECTICIDE. METABOLISM OF O, O-DIETHYL O-3,5,6-TRICHLORO-2-PYRIDYL PHOSPHOROTHIOATE-^{36}Cl IN RATS. J. agric. Fd. Chem. 15, 1 (1967) 132-138.

When O, O-diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate-^{36}Cl is fed as a single dose to rats, the radioactivity is eliminated rapidly via the urine (90%) and faeces (10%). The products excreted are 3,5,6-trichloro-2-pyridyl phosphate-^{36}Cl (75-80%), 3,5,6-trichloro-2-pyridinol-^{36}Cl (15-20%), with traces of O, O-diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate. Only the O,O-diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate-^{36}Cl accumulates in the tissues. This accumulates in the fat and is liberated slowly. (CA 66: 1967, 54496x)

793 Smith, G.N., Watson, B.S., Fischer, F.S. INVESTIGATIONS ON DURSBAN INSECTICIDE. METABOLISM OF O,O-DIETHYL O-3,5,6-TRICHLORO-2-PYRIDYL PHOSPHOROTHIOATE AND 3,5,6-TRICHLORO-2-PYRIDINOL IN PLANTS. J. agric. Fd Chem. 15, 5 (1967) 870-877.

Studies on the absorption, translocation, and metabolism of [^{36}Cl] Dursban, [^{14}C] Dursban, [^{36}Cl] 3,5,6-trichloro-2-pyridinol, and [^{14}C] 3,5,6-trichloro-2-pyridinol in plants show that Dursban is not absorbed into the plant, although it accumulates on the surface of the roots. Once it enters the plant it appears to be metabolised to form primary hydrolysis products where the phosphorus is still attached to the 3,5,6-trichloro-2-pyridinol. The rate at which the 3,5,6-trichloro-2-pyridinol enters the plant depends on the pH of the solution. The sodium salt enters the plant more than five times faster than the free pyridinol. The pyridinol undergoes metabolism with the liberation of chloride and the formation of several decomposition products. (Auth.)

794 Spiller, D. DIGEST OF AVAILABLE INFORMATION ON INSECTICIDE MALATHION. Adv. Pest Control Res. 4 (1961) 249-335.

The use of ^{32}P-labelled malathion is described in two chapters of this digest: (1) Concerning the residues in animal products where no detectable malathion was found in cuts of foreleg, hindleg, and rump of heifers sacrificed two weeks after application of 0.5% ^{32}P-malathion emulsion spray, but water-soluble meraboiites were detected in meat cuts and in thymus, thyroid, pancreas, liver, and bone to the extent of 0.05-2.0 ppm. (2) Where the effects of malathion on pest nematodes is concerned when hens were fed 100 ppm of ^{32}P-malathion in the diet and large numbers of dead round worms were eliminated in the droppings in the first few days. (Battelle Institute Card File)

795 Stiasni, M., Rehbinder, D., Deckers, W. ABSORPTION, DISTRIBUTION, AND METABOLISM OF O-(4-BROMO-2,5-DICHLOROPHENYL)-O,O-DIMETHYLPHOSPHOROTHIOATE (BROMOPHOS) IN THE RAT. J. agric. Fd Chem. 15, 3 (1967) 474-478.

Bromophos is a new phosphorothioate insecticide of extremely low mammalian toxicity. It is widely used in controlling mosquitoes and flies. ^{3}H-Bromophos with a final activity of 2.5 mCi/mM and ^{32}P-Bromophos were used. Bromophos is absorbed via the intestine. The distribution pattern shows no accumulation. The main excretory route is in urine. Metabolic detoxication takes place by hydrolysis of the methyl phosphate and/or the phenyl phosphate bond. Neither Bromophos nor its oxygen analogue are found in urinary excretion products.

796 Stone, B.F., Brown, A.W.A. MECHANISMS OF RESISTANCE TO FENTHION IN Culex fatigans. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 42, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Larvae of a fenthion-resistant strain of C. fatigans absorbed only about half as much ^{32}P-fenthion as its susceptible counterpart strain. Of the material absorbed, the resistant strain hydrolysed almost twice as high a proportion as the susceptible strain. A strain of intermediate resistance metabolised less and absorbed more than the resistant strain. The metabolites are being investigated. (Abstr.)

797 Uchida, T., Zschintsch, J., O'Brien, R.D. RELATION BETWEEN SYNERGISM AND METABOLISM OF DIMETHOATE IN MAMMALS AND INSECTS. Toxic. appl. Pharmac. 8 (1966) 259-265.

Dimethoate, ^{3}H-labelled in the methoxy group, was used. Its metabolism in insects was examined in two ways. (1) In vitro: usually 20 female Musca domestica were homogenized in 10 ml of buffer, the homogenate being treated with ^{3}H-dimethoate, fractionated and counted. (2) In vivo: 36 female M. domestica or 10 milkweed bugs (mixed sexes) were injected abdominally with 1 µl of ^{3}H-dimethoate in water and treated topically with 1 µl of EPN. EPN synergizes the toxicity of dimethoate profoundly in female mice, mildly in female guinea pigs, and not at all in female house flies (Wilson and G strains) or milkweed bugs. These findings parallel the observations that EPN blocks dimethoate metabolism profoundly (80%) in mice, less in guinea pigs (60%), and not at all in house flies and milkweed bugs. The data give strong support to the view that synergism in this pair of compounds is caused by blockade of metabolism. However, the ability of EPN to distinguish between the amidase and phosphatase pathways is not so clear-cut as in the corresponding carboxyesterase and phosphatase pathways for malathion, whose toxicity is also synergized by EPN.

798 Walker, P.T. PHORATE FOR INSECT CONTROL IN MAIZE. (I. CONTROL OF FRIT FLY.) II. UPTAKE AND DISTRIBUTION OF RADIOACTIVE PHORATE. Tropical Pesticides Research Unit Report No. 293. Porton Down, Salisbury, England. March 1965.

... In previous years furrow treatment was most effective. Radioactive tracing of ^{32}P-phorate showed that uptake of phorate is longer but less intense after furrow treatment... Phorate metabolism is discussed. Methods of radioactive granule preparation, plant extraction, radioassay, and autoradiography are described, with references. (From auth. summary)

799 Whetstone, R.R., Phillips, D.D., Sun, Y.P., Ward, L.F., Jr., Shellenberger, T.E. 2-CHLORO-1-(2,4,5-TRICHLOROPHENYL) VINYL DIMETHYL PHOSPHATE, A NEW INSECTICIDE WITH LOW TOXICITY TO MAMMALS. J. agric. Fd Chem. 14, 4 (1966) 352-356.

Single doses of the ^{32}P-labelled compound (I) in soybean oil were administered via stomach tube to male and female rats of a Wistar-derived strain. Dosages were 1.0 mg (2.9 µCi) equivalent to 5.1 mg/kg of body weight for the males and 0.8 mg (2.3 µCi) or 4.9 mg/kg for the females. The excretion of metabolites is tabulated. The ^{32}P in the urine was present in metabolites of I, no intact I being detected. Dimethyl hydrogen phosphate, and "desmethyl I" were identified. Compounds in the faeces were not identified. 2-Chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate (SD 8447) has shown excellent toxicity to several species of insects in laboratory and field tests but is remarkably safe to laboratory mammals in acute and two-week feeding tests. The poor solubility or partition properties of the compound may limit penetration and translocation in mammals so that amounts of the compound in blood and tissues are low enough to be metabolised without toxic effect.

800 Winteringham, F.P.W. LABELLED REAGENTS AND SUBSTRATES IN PESTICIDE ANALYSIS. p.96-100 of "Radioisotopes in the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, Austria, 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria). 1966, 118p.

The possibility of exploiting the radiometric technique for the differentiation and determination of organophosphate and carbamate residues is under investigation. The experimental and theoretical bases for this approach are discussed.

801 Young, S.Y., III. RADIOSYNTHESIS AND METABOLISM OF METHYLTHIO ARYL PHOSPHOROTHIONATES IN CALVES AND BLOOD SUCKING ARTHROPODS. Diss. Abstr. 28, 1 (1967) 226-B.

A technique was developed for the radiosynthesis of ^{35}S-labelled p-hydroxyaryl methyl thioethers which can be used as intermediates in the synthesis of several organophosphorus insecticides. This technique was then used to synthesise ^{35}S-Bayer 9017 (O-O-diethyl-O-[^{35}S-4-(methylthio)-3,5-xylyl] phosphorothioate). The Bayer 9017 was purified on a Florisil column with gas chromatography being used to monitor the elution of the ^{35}S-Bayer 9017 and side reaction products from the column. The metabolism and associated residues of ^{35}S-Bayer 9017 were studied in dairy calves using radiotracer techniques. Two calves were treated, one orally at the rate of 50 mg/kg with a solution containing 52% of Bayer 9017 and the 2nd calf treated dermally, at the rate of 310 mg/kg with a solution of 2% Bayer 9017. The calves were held for 24 h after treatment during which time blood samples were taken at 4 h intervals with urine and faeces collected quantitatively. ^{35}S-Bayer 9017 and its metabolites were isolated and identified by selective solvent extraction and thin-layer co-chromatography. Bayer 9017 was quickly degraded in the calves to hydrolytic products and rapidly eliminated in the urine primarily as water soluble conjugates of the phenols. The peak concentrations of radioactivity in the urine of both calves were reached at 6 h after treatment. Little elimination of ^{35}S-materials occurred in the faeces and most that was excreted consisted of organo-soluble materials. Bayer 9017 and all five of its oxidation products were found in both the urine and faeces. – Levels of radioactivity in the blood in both calves were highest at 12 h after treatment with the level in the calf treated dermally being somewhat higher than in the calf treated orally. Residues of Bayer 9017 present in most tissues were much higher in the calf treated dermally; residues in the muscle tissue were six times higher than in the calf treated orally. Much of the radioactivity in the tissues was present as hydrolytic products, primarily as water soluble conjugates with little free phenols being present in most tissues. Activation of Bayer 9017 occurred in both the thiophosphoryl and thioether groups with all five possible oxidation products being present. – In the 3rd phase of this investigation, the absorption and metabolism of ^{35}S-fenthion in two species of blood sucking arthropods, the stable fly, Stomoxys calcitrans (L.), and bed bug, Cimex lectularius L., were studied. Eight groups of each species were treated topically with one µl of a 0.4 ppm solution of fenthion in acetone. Two replicates of each species were sacrificed at 0, 1, 4, and 24 h after treatment. It was observed that nearly 90% of the ^{35}S-fenthion was absorbed by the stable fly. Activation in this insect was rapid with 35% of the absorbed dose being present as oxidation products after one hour. All five possible oxidation products were present. However, after 24 h much of the absorbed dose had been degraded and one-half of this dose had been excreted as water soluble conjugated phenols. – Absorption of fenthion by the bed bug was not as rapid as in the stable fly. Only 50% of the application was absorbed after 24 h. Degradation and excretion were also slower in the bed bug and only 18% of the absorbed dose was excreted after 24 h. The oxidation products formed in the bed bug were similar to those found in the stable fly. (DA)

802 Zuckerman, B.M., Miller, C.W., Devlin, R.M., Tomlinson, W.E., Norgren, R.L. PARATHION STUDIES ON BEAN GROWN IN STERILE ROOT CULTURE. J. econ. Ent. 59, 5 (1966) 1157-60.

Details of the extraction, chromatographic and autoradiographic procedures are given. ^{35}S-parathion was used. Parathion was detected in young bean leaflets 2 h following application to soil of plants grown in sterile root culture. Studies of accumulation of parathion within the plant during 24 h following soil application indicated that uptake continued during this period, but slowed considerably after 6 h. Results of analysis for parathion degradation products from tissue extracts indicated that most, if not all, of the parathion molecule remained intact within the plant after >22 h. Higher concentrations of parathion occurred at outer margins than in the central portions of the leaf blade. The insecticide appeared to be transported selectively by certain leaflet veins. Younger leaflets accumulated higher concentrations than did older leaflets over the same period. Parathion was not detected in root exudates 24 h following foliar application. Several species of sucking insects [the citrus mealybug, Planococcus citri (Risso), an aphid, Macrosiphum pelargonii (Kaltenbach), and the greenhouse whitefly, Trialeurodes vaporariorum (Westwood)] apparently fed but did not die after being exposed to leaves for 24 h following soil application. In one test, low levels of parathion or parathion-associated metabolites were detected in extracts from insects after 24 h exposure.

See also:

486 The artificial feeding of phosphamidon to Myzus persicae: I. Intraspecific differences exhibited by this aphid on feeding through a parafilm membrane. (Parry, W.H. et al., 1967)
586 The use of isotopes to study pesticide translocation in natural environments. (Peterle, T.J., 1966)
610 The relation between physical properties and uptake of insecticides by eggs of the large milkweed bug. (Bracha, P. et al., 1966)
835 Degradation of insecticides by the human and the rat liver. (Matsumura, F. et al., 1966)
1726 Electron microscope radioautography as a quantitative tool in enzyme cytochemistry. I. The distribution of acetylcholinesterase at motor end plates of a vetebrate twitch muscle. (Salpeter, M.M., 1967)
1757 Radioactive nuclides in pesticide chemistry. II. (Dedek, W., 1967)

1.5.5. Carbamates

803 Abdel-Wahab, A.M., Kuhr, R.J., Casida, J.E. FATE OF ^{14}C-CARBONYL-LABELLED ARYL METHYLCARBAMATE INSECTICIDE CHEMICALS IN AND ON BEAN PLANTS. J. agric. Fd Chem. 14, 3 (1966) 290-298.

Studies with eight ^{14}C-carbonyl-labelled aryl methylcarbamates demonstrate that such insecticide chemicals are degraded with the carbamate moiety intact when applied to glass or silica gel surfaces or leaves of growing bean plants, or injected into the stems of such plants. Methylcarbamates-carbonyl-^{14}C of the following phenols were examined: 1-naphthol (carbaryl), 2-isopropoxyphenol (Baygon), 3-isopropylphenol (UC 10854), 3,5-diisopropylphenol (HRS-1422), 2-chloro-4,5-xylenol (Banol), 4-methylthio-3,5-xylenol (Mesurol), 4-dimethylamino-3,5-xylenol (Zectran), and 4-dimethylamino-3-cresol (Matacil). Rates of loss vary considerably with the nature of the surface (inert or plant), the light, and the compound. Oxidative changes occur on and/or in the plant: Mesurol degrades to sulfoxide and sulfone analogues; Zectran and Matacil form several methylcarbamate derivatives, including the 4-methylamino, 4-amino, 4-methylformamido, and 4-formamido analogues. Little or no formation of organoextractable degradation products, containing an intact methylcarbamate moiety, occurs with the other compounds. The fate of the radiocarbon, 6 d after injection into bean plants, varies considerably: with Baygon and UC 10854 the majority of the radiocarbon is in the water phase; with Zectran and Matacil it appears in the unextractable portion; with Mesurol, it shows up as loss, possibly as the result of expiration as $^{14}CO_2$. Loss from the plant surface is not directly related to the volatility of the compounds, nor is degradation in the plant related to the rate of non-enzymatic hydrolysis. It appears that the relative stability of the methylcarbamate grouping to photooxidation and metabolism, in certain cases, allows the formation of degradation products involving only alteration of the ring or a ring substituent. (Auth.)

804 Abdel-Wahab, A.M. DEGRADATION OF METHYLCARBAMATE INSECTICIDES ON PLANT FOLIAGE. Diss. Abstr. 27, 10 (1967) 3428-B - 3430-B.

The following methylcarbamates labelled with ^{14}C in the carbonyl position were examined: Banol (2-chloro-4,5-xylyl methylcarbamate), Baygon (2-isopropoxyphenyl methylcarbamate), carbaryl (1-naphthyl methylcarbamate), HRS-1422 (3,5-diisopropylphenyl methylcarbamate), Matacil (4-dimethylamino-3-cresyl methylcarbamate), Mesurol (4-methylthio-3,5-xylyl methylcarbamate), UC 10854 (3-isopropylphenyl methylcarbamate), and Zectran (4-dimethylamino-3,5-xylyl methylcarbamate). - Volatility of the labelled methylcarbamates was investigated under laboratory conditions. Rate of loss of the compounds from glass surfaces was characteristic of a first-order reaction except in the cases of Matacil, Mesurol and Zectran where two components with different rates of loss were evident. The complex nature of the volatility curve for Zectran was due to the formation of degradation products which were more stable and less volatile than the original compound. Stability of the methylcarbamates to light was examined by exposure of non-labelled compounds on silica gel plates. All the carbamates were stable when exposed in the dark, or to visible or long wavelength ultraviolet light. On exposure to short wavelength u.v. light, carbaryl was unaffected,

Zectran was extensively degraded, and the other compounds were of intermediate stability. These carbamates were also applied to the leaves of growing young bean plants and the plants were exposed outdoors to direct sunlight. Leaf samples were taken at intervals up to 72 h after treatment, and washed with chloroform to recover the labelled materials from the leaf surfaces. The total recovered radioactivity was determined and the degradation products were quantitatively analysed by thin-layer chromatography, radioautography and scintillation counting. The persistence of these methyl-carbamates can be divided into three categories according to the % of total carbonyl-^{14}C remaining (original compounds plus carbamate-degradation products) after 3 d of exposure on the foliage: (a) those in which < 10% was recovered, including Baygon and UC 10854; (b) those in which 20-35% was recovered, including Banol, HRS-1422 and Matacil; (c) those in which >45% was recovered, including carbaryl, Mesurol and Zectran. Zectran and Matacil appeared to be the least stable compounds and were each decomposed to yield more than ten carbamates within 24-h exposure. Mesurol was oxidized in part to its sulfoxide and sulfone derivatives on exposure to sunlight on foliage, and limited evidence indicates that Matacil is converted to its 4-methylamino and 4-formamido analogues. The four major degradation products of Zectran on bean foliage have been tentatively identified. Identification was based on co-chromatography with authentic samples prepared by oxidation of Zectran by neutral permanganate. The four products were 4-methylformamido-3,5-xylyl methylcarbamate; 4-methylamino-3,5-xylyl methylcarbamate; 4-formamido-3,5-xylyl methylcarbamate. Considerably specificity in biological activity occurred within the series of Zectran degradation products. Zectran was more potent than any of these compounds to house-flies(Musca domestica L.)following topical application, or as an in vitro inhibitor of fly head cholinesterase. The 4-methylamino and 4-amino analogues were very potent when assayed for anticholinesterase activity using human plasma or for toxicity on injection into mice. The two formamido analogues were of lower biological activity. (From DA)

805 Abdel-Wahab, A.M., Casida, J.E. PHOTOOXIDATION OF TWO 4-DIMETHYLAMINOARYL METHYLCARBAMATE INSECTICIDES(ZECTRAN AND MATACIL) ON BEAN FOLIAGE AND OF ALKYLAMINOPHENYL METHYLCARBAMATES ON SILICA GEL CHROMATOPLATES. J. agric. Fd Chem. 15, 3 (1967) 479-487.

Carbonyl-^{14}C-labelled samples of Zectran and Matacil, with a specific activity of 1.0 mCi/mM and a radiochemical purity >99%, were used. Dimethylamino-labelled Zectran and Matacil were prepared by reaction of amino Zectran (4-amino-3,5-xylyl methylcarbamate) and Matacil (4-amino-3-cresyl methylcarbamate), respectively, with either formaldehyde-^{14}C or formaldehyde-^{3}H (see ref. III/451). A 64-80% yield was finally obtained of Zectran-N-methyl-^{14}C (0.20 mCi/mM), Zectran-N-methyl-^{3}H (10 mCi/mM), and Matacil-N-methyl-^{14}C (0.4 mCi/mM). - Photodecomposition of Zectran and Matacil deposits on bean foliage involves extensive oxidation of the dimethylamino moiety but, apparently, not of other groups. The methylcarbamate degradation products include the toxic 4-methylamino and 4-amino analogues, the less toxic 4-methylformamido and 4-formamido analogues, and trace amounts of other unidentified, biologically active methylcarbamates. Zectran is less stable than Matacil to photooxidation. In the photodecomposition, the dimethylamino moiety is stepwise demethylated and, concurrently, one of the methyl radicals is oxidized to the formamido group. Many alkylaminophenyl methylcarbamates appear to be susceptible to these reactions.

806 Andrawes, N.R. METABOLISM OF 2-METHYL-2-(METHYLTHIO)-PROPIONALDEHYDE O-(METHYLCARBAMOYL)-OXIME (TEMIK) IN MAMMALS AND INSECTS. Diss. Abstr. 28, 2 (1967) 724-B.

Four separate radiolabelled preparations of the parent compound and two preparations of its sulfoxide derivative were used. These preparations were as follows: 2-methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl-carbonyl-^{14}C)oxime, 2-methyl-2-(methylthio-^{35}S)propionaldehyde O-(methylcarbamoyl)oxime, 2-methyl-2-(methyl-^{14}C-thio)propionaldehyde O-(methylcarbamoyl) oxime, 2-methyl-2-(methylthio)propionaldehyde-2-^{14}C O-(methylcarbamoyl)oxime, 2-methyl-2-(methylsulfinyl)propionaldehyde O-(methylcarbamoyl-carbonyl-^{14}C)oxime, and 2-methyl-2-(methylsulfinyl-^{35}S)propionaldehyde O-(methylcarbamoyl)oxime. Degradation of Temik, in vitro, by various subcellular fractions of rat liver was found to be inefficient unless these systems were fortified with reduced nicotinamide-adenine dinucleotide phosphate. The greatest metabolism occurred after incubation of Temik with the 15 000 G solubles fortified with $NADPH_2$ which resulted in degradation of 95% of the material. Five chloroform-extractable metabolites were formed by

this enzyme system. These metabolites were isolated by thin layer chromatography and tentatively identified as: 2-methyl-2-(methylsulfinyl)propionaldehyde O-(methylcarbamoyl)oxime, 2-methyl-2-(methylsulfonyl)propionaldehyde O-(methylcarbamoyl)oxime, 2-methyl-2-(methylthio)propionaldoxime, 2-methyl-2-(methylsulfonyl)propionaldoxime. The major metabolite formed by the 15 000 *G* solubles of rat liver was the methylsulfinyl derivative of Temik which constituted approx. 50% of the total materials. Additional degradative product(s) of a water soluble nature were present. Oral administration of Temik to rats resulted in approx. 80% of the dose being eliminated in the urine within 24 h. An additional 4% of the dose was detected in the faeces. Total elimination of Temik residues required 24 d. Studies with carbonyl-^{14}C Temik revealed that approx. 60% of the administered dose was hydrolysed within 24 h as indicated by the amount of carbon dioxide-^{14}C that was evolved by the rats. Only a trace amount of Temik, per se, was found in the excreta, indicating a very rapid degradation of the carbamate within the animals. Analysis of urine from treated rats indicated the presence of the same metabolites that were formed by the rat liver enzymes. In addition, two chloroform-extractable metabolites were isolated from the urine and tentatively identified as: 2-methyl-2-(methylsulfinyl)-propionitrile and 2-methyl-2-(methylsulfonyl)propionitrile. The latter metabolite was the major metabolite present in the urine one week after treatment. Orally administered methylsulfinyl derivative of Temik was excreted by rats more slowly than the parent compound. With carbonyl-^{14}C material, this compound resulted in approx. 36% of the dose given off as carbon dioxide-^{14}C by the rats after 24 h. Degradation resulted in most of the urinary metabolites detected after Temik treatment. However, a major part of the administered sulfinyl compound was eliminated unchanged in the urine indicating that this material was more stable to enzymatic attack than the parent compound. Boll weevils, Anthonomus grandis Boheman, and house flies, were treated topically with Temik. From 40-80% of the applied material was absorbed during the 1st hour after dosing. Most of the absorbed material was eliminated by deficiation. Temik was metabolised to its sulfinyl and sulfonyl derivatives by both insect species. The former was the major metabolite during the first 4 h. In vitro anticholinesterase studies showed that the sulfinyl analogue of Temik was a 3-5 times more potent cholinesterase inhibitor than Temik. Conversely, Temik was more toxic than its sulfinyl analogue when applied topically to boll weevils and house flies. (From DA)

807 Andrawes, N.R., Dorough, H.W. METABOLIC FATE OF CARBARYL-NAPHTHYL-C^{14} IN BOLL WEEVILS AND BOLLWORMS. J. econ. Ent. 60, 2 (1967) 453-456.

Adult boll weevils, Anthonomus grandis Boh., were treated topically and bollworm, Heliothis zea (Boddie), larvae and adults were treated by injection with carbaryl-naphthyl-^{14}C. Hydrolytic as well as oxidative mechanisms were involved in the degradation of the carbamate in both species. Chloroform-extractable metabolites tentatively identified were: 1-naphthol; 1-hydroxy-5,6-dihydro-5,6-dihydroxynaphthalene; 5,6-dihydro-5,6-dihydroxy-1-naphthyl N-methylcarbamate; and 1-naphthyl N-hydroxy-methylcarbamate. Unknown metabolites of a water-soluble nature were predominant in both insect species. (Auth.)

808 Andrawes, N.R., Dorough, H.W., Lindquist, D.A. DEGRADATION AND ELIMINATION OF TEMIK IN RATS. J. econ. Ent. 60, 4 (1967) 978-987.

Four separate preparations of radiolabelled Temik were used (carbonyl-^{14}C-, S-methyl-^{14}C-, ^{35}S-, tert-butyl-^{14}C-Temik), as were two preparations of its sulfoxide derivative (^{35}S-Temik sulfoxide and carbonyl-^{14}C-Temik sulfoxide). Oral administration of Temik® (2-methyl-2-(methylthio)-propionaldehyde O-(methylcarbamoyl) oxime) to rats resulted in approx. 80% of the dose being eliminated in the urine within 24 h. An additional 4% of the dose was detected in the faeces. Only a trace amount of Temik, per se, was found in the excreta, indicating a very rapid degradation of the carbamate within the animals. The following metabolites were isolated from the urine by extraction with chloroform and tentatively identified: (a) 2-methyl-2-(methylthio) propionaldoxime; (b) 2-methyl-2-(methylsulfinyl) propionaldoxime; (c) 2-methyl-2-(methylsulfonyl)propionaldoxime; (d) 2-methyl-2-(methylsulfinyl) propionitrile; (e) 2-methyl-2-(methylsulfonyl)-propionitrile; (f) 2-methyl-2-(methylsulfinyl) propionaldehyde O-(methylcarbamoyl) oxime and (g) 2-methyl-2-(methylsulfonyl) propionaldehyde O-(methylcarbamoyl)-oxime. Approx. one-half of the metabolites in the urine could not be extracted into organic solvent and their identity was not determined. The methylsulfinyl derivative of Temik was excreted more slowly than the parent compound when given orally to rats.

809 Baker, M.W., Crampton, E.L., Harrison, I.R., Watkins, T.I. RESIDUES OF BUTACARB IN SHEEP MUSCLE, FAT, LIVER AND KIDNEY FOLLOWING DIPPING FOR THE CONTROL OF SHEEP BLOWFLY (Lucilia spp.). J. Sci. Fd Agric. 18, 9 (1967) 392-395.

Sheep were dipped in butacarb and subsequently slaughtered and assays were done on meat, fat, kidney and liver residues. Two methods of analysis have been used, a radiotracer and a chemical method. Even after two dippings residues were appreciably less than 1 ppm in all the tissues. In the 1st series of radioactive assays lambs were dipped in a mixture containing doubly (^{3}H and ^{14}C) labelled butacarb (3,5-di-t-butylphenyl-N-methylcarbamate)(by tritiating purified 3,5-di-t-butylphenol, and then synthesising butacarb from it by reacting with phosgene, then with ^{14}C-methylamine). In another series butacarb was labelled with ^{14}C only (N-methyl grouping, prepared from ^{14}C-methylamine). They indicated that the tissue residues did not contain hydrolytic breakdown products of the drug.

810 Baron, R.L. METABOLISM OF BANOL (6-CHLORO-3,4-XYLYL METHYLCARBAMATE) IN THE RAT. Bull. ent. Soc. Am. 12 (1966) 264. Abstr. 54, at "Portland Meeting, Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

The metabolic fate of Banol following sub-acute inoxication was observed in rats using the molecule labelled in three positions (methyl ring, carbonyl and N-methyl). The distribution of the carbamate, isolation and characterisation of metabolic products, and studies on a pharmacodynamic stress-response relationship to metabolism was discussed. (From abstr.)

811 Baron, R.L., Doherty, J.D. METABOLISM AND EXCRETION OF AN INSECTICIDE (6-CHLORO-3,4-DIMETHYLPHENYL N-METHYLCARBAMATE) IN THE RAT. J. agric. Fd Chem. 15, 5 (1967) 830-836.

The metabolic fate of the carbamate insecticide Banol, following acute oral administration to the rat, was investigated. Recovery in urine, faeces, tissues, and as expired $^{14}CO_2$ of the administered dose of ring-methyl-^{14}C, carbonyl-^{14}C, and N-methyl-^{14}C-Banol was 100, 99, and 80%, respectively. Urinary water-soluble metabolites include methylamine and three to five groups of acidic conjugated components. One of these groups, the uronic acids, comprising 76-81% of the acidic components, was resolved into four components. Indirect evidence has been presented for the conjugation of Banol and a uronic acid to form a carbamate N-glucuronide. Physical stress affected the rate of release of $^{14}CO_2$ following administration of N-methyl-^{14}C-Banol. Physical stress appears to have a selective effect on the hydrolytic pathway of carbamate degradation. (Auth.)

812 Bartley, W.J., Heywood, D.L., Steele, T.E.N., Skraba, W.J. SYNTHESIS OF C^{14}-LABELED 2-METHYL-2-(METHYLTHIO)PROPIONALDEHYDE O-(METHYLCARBAMOYL)OXIME. J. agric. Fd Chem. 14, 6 (1966) 604-607.

The synthesis of 2-methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl)oxime (Temik) with a ^{14}C tag at three different sites in the molecule has been accomplished. These were: S-methyl-^{14}C Temik, obtained by reaction of methyl-^{14}C-mercaptan with 2-chloro-2-methyl-1-nitrosopropane dimer; tert-^{14}C Temik, obtained in an eight-step synthesis starting with tagged barium carbonate; and N-methyl-^{14}C Temik resulting from reaction of the appropriate aldehyde oxime with methyl-^{14}C isocyanate. The tagged methyl isocyanate was prepared in good yield by a new method involving reaction of N,N'-carbonyldiimidazole and methyl-^{14}C-amine hydrochloride. The N-methyl-^{14}C sulfoxide of Temik [2-methyl-2-(methylsulfinyl)propionaldehyde O-(methyl-^{14}C-carbamoyl)oxime] was prepared by peracid oxidation of labelled Temik. (Auth.)

813 Bull, D.L., Lindquist, D.A., Coppedge, J.R. ABSORPTION AND METABOLISM OF TEMIK® BY INSECTS. Bull. ent. Soc. Am. 12 (1966) 264. Abstr.55, at "Portland Meeting, Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

The absorption and metabolism of Temik® by adult boll weevils and tobacco budworm larvae were compared using thin-layer chromatography and conventional radiometric procedures. The Temik used was radiolabelled in three different positions with ^{14}C or with ^{35}S. (Abstr.)

814 Bull, D.L., Lindquist, D.A., Coppedge, J.R. METABOLISM OF 2-METHYL-2-(METHYLTHIO) PROPIONALDEHYDE O-(METHYLCARBAMOYL) OXIME (TEMIK, UC-21149) IN INSECTS. J. agric. Fd Chem. 15, 4 (1967) 610-616.

The fate of radiolabelled 2-methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl)oxime (Temik, UC-21149) in insects was examined. Samples of Temik labelled either with ^{14}C at the S-methyl (specific activity 4.9 mC/mM), tertiary (3.9 mCi/mM), and carbonyl (2.5 mCi/mM) positions, or with ^{35}S (initial specific activity of 10.8 and 55.8 mCi/mM) were used. Adult boll weevils, Anthonomus grandis Boh., Musca domestica L., 3rd- or 5th-instar bollworms, Heliothis zea (Boddie), and tobacco budworms, Heliothis virescens (F.) were tested. Topically applied Temik was absorbed rapidly by adult Anthonomus but very slowly by 3rd-instar Heliothis virescens (F.). Oxidation at the sulphur atom was the predominant reaction in both species of insects, yielding primarily the sulfoxide derivative of Temik and to a lesser extent the sulfone. Traces of N-demethyl derivatives in excreta of the tobacco budworm indicated some oxidation at the N-methyl position. The principal products of hydrolysis were the sulfoxide and sulfone derivatives of 2-methyl-2-(methylthio)propionaldehyde oxime.

815 Camp, H.B., Arthur, B.W. ABSORPTION AND METABOLISM OF CARBARYL BY SEVERAL INSECT SPECIES. J. econ. Ent. 60, 3 (1967) 803-807.

The absorption and metabolism of ^{14}C carbaryl was studied in the house fly, Musca domestica L.; stable fly, Stomoxys calcitrans (L.); boll weevil, Anthonomus grandis Boheman; and rice weevil, Sitophilus oryza (L.). Following topical applications of carbaryl, the percentage of the applied dose absorbed by each species of insect within 24 h was: stable fly 56.7%, housefly 37.3%, boll weevil 12.2%, and rice weevil 3.3%. Five metabolites, including 1-naphthol, were isolated from insects by Florosil and thin-layer chromatography; four metabolites were unidentified. Carbaryl was quite stable in both species of weevils. The major metabolite in the faeces of houseflies was a highly polar material. There were no qualitative differences in number of metabolites isolated from houseflies, boll weevils, and rice weevils, but there were quantitative differences in each metabolite present in the internal extract. The species specificity of carbaryl appeared to be functions of rate of absorption and enzymatic degradation within the particular insect species. (Auth.)

816 Coppedge, J.R., Lindquist, D.A., Bull, D.L., Dorough, H.W. FATE OF 2-METHYL-2-(METHYLTHIO)PROPIONALDEHYDE O-(METHYLCARBAMOYL) OXIME (TEMIK) IN COTTON PLANTS AND SOIL. J. agric. Fd Chem. 15, 5 (1967) 902-910.

The metabolic fate of ^{35}S-, ^{14}C-(carbonyl), ^{14}C-(S-methyl)-, and ^{14}C-(tertiary) Temik as well as ^{35}S-Temik-sulfoxide, ^{35}S-Temik-sulfone, and ^{35}S-oxime was studied in young mature excised cotton leaves. The fate of ^{35}S-Temik was also studied in soil. In the cotton plant, Temik [10% granular formulation of UC-21149, 2-methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl) oxime] was rapidly metabolised to its sulfinyl derivative (Temik-sulfoxide); further oxidation to the sulfonyl compound (Temik-sulfone) was slow. No evidence of oxidative N-demethylation was found. The sulfinyl derivative was degraded primarily by hydrolysis to a sulfinyl-oxime. Both Temik-sulfoxide and Temik-sulfone were stable in cotton. Relatively large amounts of radioactivity were lost from ^{14}C-Temik-treated excised cotton leaves. In the three soil types studied under laboratory conditions, Temik was degraded more slowly than in cotton. However, similar metabolites were recovered from both cotton plants and soil.

817 Dorough, H.W. CARBARYL-C^{14} METABOLISM IN A LACTATING COW. J. agric. Fd Chem. 15, 2 (1967) 261-266.

Carbaryl-naphthyl-^{14}C (1-naphthyl N-methylcarbamate) administered in the feed to a lactating cow at single doses of 0.25 and 3.05 mg/kg resulted in radiolabelled residues in the milk for as long as 60 h after treatment. Approx. 0.35% of each dose was detected in the milk. Max. concentrations were found in 6-h samples which, following the two treatments, were 0.063 and 0.950 ppm, respectively. The major chloroform-extractable metabolite from the milk was tentatively identified as 5,6-dihydro-5,6-dihydroxy-1-naphthyl N-methylcarbamate. Approx. 30% of all residues in the 6-h samples was this product. After the 0.25 mg/kg treatment, 70% of the dose was detected in the urine and 11% in the faeces. The percentages of the 3.05 mg/kg dose excreted in the urine and faeces were 58 and 15, respectively. Analysis of 27 tissue samples, taken 6 d after the 3.05 mg/kg treatment, revealed that residues were highest in the liver, kidney, and ovaries, although these residues were present only in trace amounts. (Auth.)

818 Dorough, H.W., Ivie, G.W. TEMIK-S^{35} (UC-21149) METABOLISM IN A LACTATING COW. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 30, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA, 27-30 Nov. 1967".

Percentages of a 0.1 mg/kg dose of Temik eliminated in the urine, milk and faeces of a dairy cow were 90.2, 3.0, and 2.9. Milk residues consisted primarily of organic solvent extractables and of small quantities of water soluble and unextractable products. (Abstr.)

819 Egan, H. IUPAC COMMISSION ON TERMINAL RESIDUES. J. Ass. off. analyt. Chem. 50, 5 (1967) 1071-1073.

The commission discussed the present position regarding knowledge of the nature of terminal residues of carbamates, including carbaryl. An evaluation was presented by J. W. Cook (Division of Food Chemistry, Food and Drug Administration, Washington, D.C. 20204). A number of studies are cited (Dorough, Knaak, Casida et al.) in which radioisotopes had been used in metabolic and residue studies on various animals, in animal tissues and animal products.

820 Friedman, A.R., Lemin, A.J. METABOLISM OF 2-CHLORO-4,5-DIMETHYLPHENYL N-METHYLCARBAMATE IN BEAN PLANTS. J. agric. Fd Chem. 15, 4 (1967) 642-647.

The insecticide Banol, 2-chloro-4,5-dimethylphenyl N-methylcarbamate, is absorbed from solution and metabolised to a water-soluble metabolite by bean plants. This metabolite was shown to have the carbamate side chain intact and to have the ring modified by hydroxylation and conjugation with glucose. The synthesis of Banol-4-methyl ^{14}C is described, via 4-bromo-3-methylphenol, 4-bromo-3-methylphenyl benzyl ether, 4-carboxy-^{14}C-3-methylphenyl benzyl ether, 4-hydroxymethyl-^{14}C-3-methylphenyl benzyl ether, 3,4-dimethylphenol (4-methyl-^{14}C), 2-chloro-4,5-dimethylphenol (4-methyl-^{14}C), and 2-chloro-4,5-dimethylphenyl N-methylcarbamate 4-methyl-^{14}C.

821 Gemrich, E.G., II. ENZYMATIC DEGRADATION OF 2-CHLORO-4,5-DIMETHYLPHENYL N-METHYLCARBAMATE BY THE FAT BODIES OF Blaberus giganteus. J. agric. Fd Chem. 15, 4 (1967) 617-621.

2-chloro-4-^{14}C,5-dimethylphenyl N-methylcarbamate (4-methyl-^{14}C Banol, 4.76 mCi/mM), N-methyl-^{14}C Banol (6.10 mCi/mM), and carbonyl-^{14}C Banol (0.539 mCi/mM) were used. The mixed function oxidase character of an enzyme system responsible for the degradation of 2-chloro-4,5-dimethylphenyl N-methylcarbamate has been demonstrated using the fat body of the cockroach, B. giganteus. Optimum conditions are reported for the microsomal fractions. Of at least three chloroform-soluble degradation products formed by the microsomal system, one has been tentatively identified as 2-chloro-4,5-dimethylphenyl N-hydroxymethylcarbamate.

822 Georghiou, G.P. DEVELOPMENT AND CHARACTERIZATION OF RESISTANCE TO o-ISOPROPOXYPHENYL METHYLCARBAMATE IN THE MOSQUITO Culex pipiens quinquefasciatus Say. Nature, Lond. 207, 4999 (1965) 883-884.

When larvae of C. pipiens fatigans Wied. (quinquefasciatus, auct.) of a strain from southern California containing both DDT- and dieldrin-resistant individuals were selected with arprocarb (Bayer 39007) by exposing the progeny of survivors of each generation to approx. the dose that would kill 90%, resistance increased rapidly in the first selected generation and more slowly thereafter, the LC 50's for the parent and F_{17} generations being 0.29 and 3.12 parts per million, respectively. The resistance ratios (defined as the LC 50 for the resistant strain divided by the LC 50 for the susceptible strain) of the selected strain to various carbamate and a few organophosphorus insecticides ranged from 1.6 for fenitrothion (Sumithion) to 6.4 and 8.3 for the m-tert-butylphenyl and the o-isopropylphenyl methylcarbamates, respectively, and 10.8 for arprocarb itself. The ratios observed are deemed to indicate a certain low-level specificity of the resistance mechanism for the ortho-substituted phenyl methylcarbamates though cross-resistance extended also to a variety of other carbamates as well as to malathion and fenthion, which had ratios of 3.1 and 4.2, respectively. There was also a small intensification of the initial DDT- and dieldrin-resistance of the parental strain. When a substrain separated from the F_9 selected generation, for which the LC 50 was 2.16 ppm was reared with exposure to insecticide for ten further generations, the LC 50 for the last two of these combined was 1.5 ppm, indicating that the resistance was stable. When 4th-instar larvae of the normal and selected strains were exposed for 2 h to ^{14}C-labelled arprocarb at 10 ppm and

extracts of them chromatographed and tested for radioactivity, the proportions of metabolites recorded for the two strains were 12.4 and 30.4%, respectively, indicating a 2.5-fold increase in the efficiency of the resistant strain in carbamate detoxication. Crossing experiments indicated that the resistance is controlled by a polygenic system. (RAE-A 54: 1966, 112)

823 Hassan, A., Zayed, S.M.A.D., Bahig, M.R.E. CARBAMATE ESTERASE, AMINE OXIDASE AND CATALASE AS INTERFERING ENZYMES IN THE METABOLISM OF SEVIN. Naturwissenschaften 53, 20 (1966) 529-530. (In English)

For assaying carbamate esterase activity, larval haemolymph of the cotton leaf worm, Prodenia litura, was incubated with ^{14}C-Sevin (substrate) at 37°C for 2 h. The $^{14}CO_2$ evolved during the reaction was trapped in 1 N NaOH solution and determined as $Ba^{14}CO_3$, and the amount of $^{14}CO_2$ was taken to be proportional to the enzyme activity. The transformation of $H^{14}COOH$ to $^{14}CO_2$ was taken as indicator for the activity of the catalase-peroxide system. The results, compared against similarly treated rat liver homogenate are tabulated in terms of carbamate esterase (1:15), monoamineoxidase (1:18), and the catalase-H_2O_2-system (1:27).

824 Ivie, G.W., Dorough, H.W. FURADAN-C^{14}(NIA-10242) METABOLISM IN A LACTATING COW. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 31, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Furadan (NIA-10242) given to a cow as a single oral dose of 0.5 mg/kg resulted in detectable milk residues for 132 h after treatment, with 1.95% of the dose being excreted by this route. The nature of the metabolites in the milk, urine and faeces was investigated. (Abstr.)

825 Kearney, P.C. PURIFICATION AND PROPERTIES OF AN ENZYME RESPONSIBLE FOR HYDROLYZING PHENYLCARBAMATES. J. agric. Fd Chem. 13, 6 (1965) 561-564.

The purification and properties of an enzyme, isolated from a soil microorganism, which catalyses the hydrolysis of isopropyl N-(3-chlorophenyl)carbamate to 3-chloroaniline are described. Purification was achieved by a combination of salt fractionation and chromatography on DEAE cellulose. The purified enzyme was characterized as to pH optimum metal ion requirement, inhibitors, and substrate specificity. Degradation of CIPC was determined by assaying for chloride ion liberation or $^{14}CO_2$ production from the labelled compound. 1 μCi of ^{14}C-CIPC (randomly labelled in the ring, specific activity 5.99 μCi/mg) was incubated with the purified enzyme. The reaction was terminated after 10 min at 30°C. Subsequent steps are described in detail. Enzymic rates of hydrolysis of several phenylcarbamates are correlated to a physical-chemical property of the substrate. Differences in rates can be explained by considering certain steric and electronic characteristics of the phenylcarbamate.

826 Knaak, J.B., Tallant, M.J., Sullivan, L.J. THE METABOLISM OF 2-METHYL-2-(METHYLTHIO)-PROPIONALDEHYDE O-(METHYLCARBAMOYL)OXIME IN THE RAT. J. agric. Fd Chem. 14, 6 (1966) 573-578.

The metabolic fate of S-methyl-^{14}C, tert-butyl-^{14}C, and N-methyl-^{14}C Temik [2-methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl)oxime] was investigated in the rat. The over-all recovery of the S-methyl, tert-butyl, and N-methyl label was, respectively, 95, 96 and 72% of the doses. Tissue residues (8-10% of the dose) were found only in the case of N-methyl labelled Temik. 70% of an oral dose of Temik was excreted as 2-methyl-2-(methylsulfinyl)propionaldehyde oxime and 2-methyl-2-(methylsulfinyl)propionaldehyde O-(methylcarbamoyl)oxime. The remaining metabolites appeared to be acids formed by further oxidation of the oxime. In conjunction with the metabolic studies, in vivo cholinesterase depression and recovery curves were obtained with plasma, red blood cells, and brain. At an oral dose of 0.33 mg/kg, the cholinesterase activity of Temik-treated rats recovered from inhibition 2 h prior to the rats treated with 2-methyl-2-(methylsulfinyl)propionaldehyde O-(methylcarbamoyl)oxime. (Auth.)

827 Krishna, J.G. METABOLISM AND PERSISTENCE OF METHYLCARBAMATE-C^{14} INSECTICIDES IN MAMMALS. Diss. Abstr. 26 (1966) 3998-3999.

Carbaryl (1-naphthyl methylcarbamate) is rapidly metabolised so that little or no residue of this compound appears in milk or persists in tissues of treated animals. Baygon (2-isopropoxyphenyl

methylcarbamate) and Zectran (4-dimethylamino-3,5-xylyl methylcarbamate) are also rapidly metabolised in mammals to yield hydrolysis products and their conjugates in urine. Liver enzymes serve to hydroxylate and oxidize many methyl- and dimethylcarbamates. Detoxication mechanisms may therefore include oxidation, hydroxylation and conjugation with or without ester hydrolysis. It therefore appeared desirable to compare the detoxication and elimination mechanisms for several methyl- and dimethylcarbamate insecticides under a standard set of conditions with mammals. The following methylcarbamates-^{14}C and ^{14}C-labelled hydrolysis products were investigated: methylcarbamates-carbonyl-^{14}C of 1) 1-naphthol, 2) 2-isopropoxyphenol, 3) 3-isopropylphenol, 4) 3,5-diisopropylphenol, 5) 2-chloro-4,5-xylenol, 6) 4-methylthio-3,5-xylenol, 7) 4-dimethylamino-3,5-xylenol, 8) 4-dimethylamino-3-cresol; methyl-^{14}C-carbamates of 9) 1-naphthol, 10) 2-isopropoxyphenol, 11) 2-chloro-4,5-xylenol; methylcarbamates of 12) 1-naphthol-1-^{14}C, 13) 2-isoprop-(1,3-^{14}C)-oxyphenol; dimethylcarbamates-carbonyl-^{14}C of 14) 1-isopropyl-3-methyl-5-pyrazolone, 15) 2-dimethylcarbamoyl-3-methyl-5-pyrazolone; hydrolysis products including 16) sodium carbonate-^{14}C, 17) methyl-^{14}C-amine hydrochloride, 18) 1-naphthol-1-^{14}C, 19) 2-isoprop-(1,3-^{14}C)-oxyphenol. Compounds 1-10 and 12 were synthesised; others were obtained by hydrolysis of the respective radiolabelled carbamates or from commercial sources. All compounds were adjusted to 1.0 mCi/mM and administered at 7.5 μM/kg. Male white rats (160-170 g) were injected intraperitoneally. Expired $^{14}CO_2$ was continuously collected over a 48-h period. Urine and faeces were collected at regular intervals. 11 representative tissues were sampled after termination of each experiment. All radioactive measurements were made by scintillation counting. Expired $^{14}CO_2$ was trapped in a mixture of 2-methoxyethanol and monoethanolamine for counting. Urine was counted directly. Faeces and tissue samples were combusted to yield $^{14}CO_2$, which was absorbed in the above mixture and counted. Each experiment was repeated so that all results represent averages of duplicate analyses of each sample from duplicate experiments. Radioactivity recoveries are reported without regard to the chemical nature of the metabolites present. Expired $^{14}CO_2$ from the carbamates-carbonyl-^{14}C ranged from $\frac{1}{4}$ for carbaryl (compound 1) to $\frac{3}{4}$ of the adminstered radioactivity for Zectran and isolan (compounds 7 and 14, respectively) while sodium carbonate-^{14}C yielded 98% as $^{14}CO_2$. Methylcarbamates-carbonyl-^{14}C without a para-substituent in the phenyl ring (group I) and those with a para-substituent in the phenyl ring (group II) behaved differently. Radioactivity from group I was largely excreted in the urine while much of the radioactivity was recovered as $^{14}CO_2$ from compounds of group II. Zectran, in general, yielded the highest and Baygon the lowest persisting tissue residues, and the liver, spleen and kidney usually retained the highest levels. The difference in distribution of the radioactivity between the methyl- and dimethylcarbamates-carbonyl-^{14}C was not as great as it was within the methylcarbamates. Methyl-^{14}C-carbamates usually yielded higher radioactivity levels in tissues and much lower in expired $^{14}CO_2$ as compared to carbonyl-^{14}C compounds. Each methyl- and dimethylcarbamate, each hydrolysis product, and each of the sites of the radiocarbon in the molecule yielded a different balance of the radioactivity which was expired as $^{14}CO_2$, excreted in urine or faeces or persisted in the tissues after 48 h. The biodegradability of methyl- and dimethylcarbamates continues to be one of the advantages of this type of insecticide. (From DA)

828 Krishna, J.G., Casida, J.E. FATE IN RATS OF THE RADIOCARBON FROM TEN VARIOUSLY LABELED METHYL- AND DIMETHYLCARBAMATE-C^{14} INSECTICIDE CHEMICALS AND THEIR HYDROLYSIS PRODUCTS. J. agric. Fd Chem. 14, 2 (1966) 98-104.

The radiocarbon content of expired CO_2, excrements, and certain tissues was determined, for the most part, 2 d after intraperitoneal administration to male white rats of 19 ^{14}C-labelled materials, as follows: eight methylcarbamates-carbonyl-^{14}C; two dimethylcarbamates-carbonyl-^{14}C; three methyl-^{14}C-carbamates; two methylcarbamates labelled in a ring or a ring substituent; four hydrolysis products. The following labelled compounds were used: -

Chemical Name	Common or Trade Name
1-naphthyl methylcarbamate-carbonyl-^{14}C	carbaryl
2-isopropoxyphenyl methylcarbamate-carbonyl-^{14}C	Baygon
3-isopropylphenyl methylcarbamate-carbonyl-^{14}C	UC-10854
3,5-diisopropylphenyl methylcarbamate-carbonyl-^{14}C	HRS-1422
2-chloro-4,5-xylyl methylcarbamate-carbonyl-^{14}C	Banol
4-methylthio-3,5-xylyl methylcarbamate-carbonyl-^{14}C	Mesurol
4-dimethylamino-3,5-xylyl methylcarbamate-carbonyl-^{14}C	Zectran

4-dimethylamino-3-cresyl methylcarbamate-carbonyl-^{14}C	Matacil
1-naphthyl methyl-^{14}C-carbamate	carbaryl
2-isopropoxyphenyl methyl-^{14}C-carbamate	Baygon
2-chloro-4,5-xylyl methyl-^{14}C-carbamate	Banol
1-naphthyl-1-^{14}C methylcarbamate	carbaryl
2-isoprop-(1,3-^{14}C)-oxyphenyl methylcarbamate	Baygon
1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate-carbonyl-^{14}C	Isolan
2-dimethylcarbamoyl-3-methyl-5-pyrazolyl dimethylcarbamate-carbonyl-^{14}C	Dimetilan
sodium carbonate-^{14}C	...
methyl-^{14}C-amine hydrochloride	...
1-naphthol-1-^{14}C	...
2-isoprop-(1,3-^{14}C)-oxyphenol	...

Expired $^{14}CO_2$ accounted for 25-77% of the radioactivity administered as carbonyl-^{14}C-labelled carbamates. Such methylcarbamates without a para-substituent in the phenyl ring gave rise to more radioactivity in the urine and less in the tissues than those with a substituent in this position. The radioactivity-distribution pattern was specific and distinctive for each methyl- and dimethylcarbamate, for each hydrolysis product, and for each of the sites of radiocarbon in the molecule.

829 Kuhr, R.J. METABOLISM OF METHYLCARBAMATE INSECTICIDE CHEMICALS IN PLANTS. Diss. Abstr. 27, 12 Pt.I (1967) 4437-B.

Ten carbonyl-^{14}C-labelled compounds were investigated as follows: 2-chloro-4,5-xylyl methylcarbamate (Banol); 2-isopropoxyphenyl methylcarbamate (Baygon); 1-naphthyl methylcarbamate (carbaryl); 1-dimethylcarbamoyl-5-methyl-3-pyrazolyl dimethylcarbamate (dimetilan); 3,5-diisopropylphenyl methylcarbamate (HRS-1422); 1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate (Isolan); 4-dimethylamino-3-cresyl methylcarbamate (Matacil); 4-methylthio-3,5-xylyl methylcarbamate (Mesurol); 3-isopropylphenyl methylcarbamate (UC 10854); 4-dimethylamino-3,5-xylyl methylcarbamate (Zectran). Additional labelled compounds were used, including: Banol N-methyl-^{14}C; Baygon isoprop-1,3-^{14}C-oxy; Baygon N-methyl-^{14}C; carbaryl N-methyl ^{14}C; carbaryl naphthyl-1-^{14}C; methyl-^{14}C-amine; 1-naphthol-1-^{14}C; sodium carbonate-^{14}C. Each of the labelled samples was individually injected into the stems of growing bean plants. At selected time intervals after treatment, the plants were extracted with acetone and chloroform to yield an organic phase, a water phase and an unextractable portion. ^{14}C-loss from the growing plant or on extraction was also recorded. The organosoluble fraction was subjected to thin-layer chromatography (TLC) and, where possible, metabolites were tentatively identified by cochromatography with known, unlabelled compounds. On metabolism in beans, Mesurol forms the sulfoxide and sulfone derivatives. Zectran yields the 4-formamido-, 4-methylformamido-, 4-methylamino- and 4-amino-3,5-xylyl methylcarbamates, while Matacil forms only the 4-formamido and 4-methylamino derivatives. Little, if any, formation of organoextractable degradation products, containing an intact carbamate moiety, occurs with the other carbamate esters. The fate of the radiocarbon, 6 d after injection into bean plants, varies considerably with different compounds: with Baygon and UC 10854 the main fraction of the radiocarbon is in the water phase; with Matacil and Zectran it appears in the unextractable portion; with Mesurol it shows up as loss, possible as the result of expired $^{14}CO_2$. Degradation within the plant is not directly related to the rate of non-enzymic hydrolysis. Horseradish peroxidase degrades Matacil and Zectran to products similar to those found in the organic phase of bean plants treated with these compounds. This enzyme does not degrade the other carbamates, and mushroom tyrosinase is without activity in carbamate degradation. Little difference is found in the ^{14}C distribution resulting from use of the three carbaryl samples, individually labelled in different positions. Most of the ^{14}C from each of the hydrolysis products appears in the unextractable portion after 6 d. Radioactive components in the water phases from plants treated with different labelled samples of Banol, Baygon, or carbaryl were partially resolved by TLC, subsequently hydrolysed with β-glucosidase, and the chemical nature of the released aglycones-^{14}C determined. Aglycones tentatively identified include: N-hydroxymethyl Banol from Banol; O-depropyl Baygon, 4-hydroxy Baygon and N-hydroxy-methyl Baygon from Baygon; 5,6-dihydro-5,6-dihydroxy carbaryl, 4-hydroxy carbaryl, 5-hydroxy carbaryl, N-hydroxy-methyl carbaryl and 1-naphthol from carbaryl. Cleavage of the glycosides, derived from each of the 10 carbonyl-labelled methyl- and dimethylcarbamates, with β-glucosidase yields several aglycones-^{14}C, most of which are

anticholinesterase agents. The relative stability of the carbamate grouping of some carbamate insecticides to metabolism in plants allows the formation of degradation products involving only alterations of the N-methyl group, the ring, or a ring substituent. Many of the initial products are similar, if not identical, to those formed in insects and mammals treated with the same carbamates; however, differences occur in the nature of the conjugates formed. In plants, the products are conjugated as persisting glycosides, and the glycosides are susceptible to cleavage by β-glucosidase to free aglycones which are anticholinesterase agents. In future studies on crop residues associated with the use of carbamate insecticide chemicals, these metabolites should be considered. (From DA)

830 Kuhr, R.J., Casida, J.E. PERSISTENT GLYCOSIDES OF METABOLITES OF METHYLCARBAMATE INSECTICIDE CHEMICALS FORMED BY HYDROXYLATION IN BEAN PLANTS. J. agric. Fd Chem. 15, 5 (1967) 814-824.

Studies with eight substituted phenyl methylcarbamate and two substituted pyrazolyl dimethylcarbamate insecticide chemicals indicate that the water-soluble metabolites formed from them, following injection into bean plants, result in part from hydroxylation of the carbamate on the N-methyl group, on the ring, or on a ring substituent, followed by conjugation of the hydroxylated carbamates mainly as glycosides. These glycosides are quite persistent and, in many cases, yield anticholinesterase agents on hydrolysis by β-glucosidase. The aglycones derived from carbaryl, which include the N-hydroxymethyl, 4-hydroxy, 5-hydroxy, and 5,6-dihydro-5,6-dihydroxy derivatives, are the same carbamate intermediates involved in carbaryl metabolism by mammals and insects. N-hydroxy-methyl formation also occurs with Banol, Baygon, and UC 10854. Hydroxylation of the tertiary carbon of the isopropyl group yields hydroxypropyl UC 10854 from UC 10854, and 2-hydroxyphenyl methylcarbamate on O-depropylation of Baygon. Horseradish peroxidase degrades Matacil and Zectran while tyrosinase systems do not metabolise the four carbamates studied. The following radioactively labelled compounds were used:

Banol carbonyl-^{14}C
Banol N-methyl-^{14}C
Baygon carbonyl-^{14}C
Baygon isoprop-1,3-^{14}C-oxy
Baygon N-methyl-^{14}C
carbaryl carbonyl-^{14}C
dihydrodihydroxy carbaryl carbonyl-^{14}C
carbaryl N-methyl-^{14}C
carbaryl naphthyl-1-^{14}C
Dimetilan carbonyl-^{14}C
HRS-1422 carbonyl-^{14}C
Isolan carbonyl-^{14}C
Matacil carbonyl-^{14}C
Mesurol carbonyl-^{14}C
UC 10854 carbonyl-^{14}C, and
Zectran carbonyl-^{14}C

831 Lamoureux, G.L., Shimabukuro, R.H. THE METABOLISM OF 4-BENZOTHIENYL-N-METHYLCARBAMATE IN BARLEY AND ALFALFA. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 29, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

The insecticide 4-benzothienyl-4,7-^{14}C-(N-methylcarbamate) is readily translocated upward in the xylem of root-treated barley and alfalfa plants. One of several conjugates of the eight n-butanol-soluble metabolites is 4-benzothienyl-β-D-glucoside. In alfalfa roots the radioactivity occurs in the lignin fraction. Lack of $^{14}CO_2$ evolution from either species suggests limited degradation. (Abstr.)

832 Leeling, N.C. METABOLITES OF CARBARYL (1-NAPHTHYL N-METHYLCARBAMATE) AND ENZYMATIC MECHANISMS FOR THEIR FORMATION. Diss. Abstr. 26 (1966) 5011-5012.

Radiotracer studies established that hydroxylation rather than hydrolysis might be the major detoxication mechanism for carbaryl. Enzymatic mechanisms for formation of the metabolites and the chemical nature and biological activity of these metabolites were therefore investigated. Carbaryl-naphthyl-1-^{14}C was metabolised to yield the same 8 ether-extractable metabolites by the liver microsome fraction from mice, rats, and rabbits. The rat liver microsome fraction was selected for a detailed study of the in vitro metabolism. Reduced nicotinamide adenine dinucleotide, or, particularly, reduced nicotinamide adenine dinucleotide phosphate was required for significant metabolism. These cofactors could be replaced by their oxidized forms if the soluble fraction from

liver was added to the microsomes. The amount of metabolism was directly proportional to the level of cofactor present, the optimum pH was 7.3, certain divalent cations increased metabolism, and several known inhibitors of microsomal oxidations decreased the metabolism. Evidence from in vitro experiments also suggested formation of ethereal sulfate, glutathione, or glucuronide conjugates for all but one of the ether-extractable metabolites. Rabbits treated with carbaryl excreted in the urine small amounts of the same metabolites produced by the microsome preparations. Three additional ether-extractable and four or five n-butanol-extractable metabolites appeared in urine of carbaryl-treated rabbits, but were absent in urine from 1-naphthol-treated rabbits. Six ether-extractable metabolites of carbaryl from urine and enzymatic preparations were tentatively identified as follows: 1-naphthyl N-hydroxymethylcarbamate; 4-hydroxy-1-naphthyl N-methylcarbamate; 5-hydroxy-1-naphthyl N-methylcarbamate; 5,6-dihydro-5,6-dihydroxy-1-naphthyl N-methylcarbamate; 1-hydroxy-5,6-dihydro-5,6-dihydroxy-naphthalene; and 1-naphthol. Methods used in identification of one or more of these metabolites were: infrared spectra, melting point, co-chromatography with known compounds on two-dimensional thin layer chromatography before and after alkaline or acid degradation, and fluorescence before and after treatment with alkali. The biological activity of the ether-extractable carbaryl metabolites was compared to that of carbaryl by cholinesterase inhibition determinations and housefly (Musca domestica L.) toxicity studies. Detectable inhibition of human plasma cholinesterase by metabolites occurred at levels five or more times greater than that of carbaryl (0.02 µg). Houseflies were each treated with 10 µg of piperonyl butoxide, α - [2-(2-butoxy-ethoxy)ethoxy]-4,5-methylenedioxy-2-propyltoluene, and varying levels of carbaryl or individual metabolites. Carbaryl gave a 24-h LD 50 of 0.05 µg/fly, but none of the metabolites produced mortality in 24 h at 10 µg/fly. (From DA)

833 Leeling, N.C., Casida, J.E. METABOLITES OF CARBARYL (1-NAPHTHYL METHYLCARBAMATE) IN MAMMALS AND ENZYMATIC SYSTEMS FOR THEIR FORMATION. J. agric. Fd Chem. 14, 3 (1966) 281-290.

Carbaryl-naphthyl-1-^{14}C was synthesised by reacting 1-naphthol-1-^{14}C with methyl isocyanate. The specific activity of carbaryl-naphthyl-1-^{14}C was adjusted to 1.0 mCi/mM (~ 2500 cpm/µg). Ether-extractable carbaryl (1-naphthyl methylcarbamate) metabolites found in the urine of treated rabbits and formed by enzyme preparations from rat, mouse, and rabbit liver are tentatively identified as follows: 1-naphthyl N-hydroxymethylcarbamate; 4-hydroxy-1-naphthyl methylcarbamate; 5-hydroxy-1-naphthyl methylcarbamate; 5,6-dihydro-5,6-dihydroxy-1-naphthyl methylcarbamate; 1-hydroxy-5,6-dihydro-5,6-dihydroxynaphthalene; and 1-naphthol. Additional unidentified metabolites are also present in ether and butanol extracts of the urine. Each of the ether-extractable metabolites formed by liver enzymes is of reduced biological activity compared with carbaryl. Optimum conditions are given for metabolism of carbaryl by rat liver microsomes plus soluble fractions; inhibition of the metabolism system by five insecticide synergists is demonstrated. Hydroxylated carbaryl metabolites are probably conjugated, in part, as glucuronides and ethereal sulfates, based on in vitro studies with conjugation systems.

834 Lindquist, D.A., Coppedge, J.R., Bull, D.L., Dorough, H.W. THE FATE OF RADIOLABELED TEMIK® IN COTTON PLANTS AND SOIL. Bull. ent. Soc. Am. 12 (1966) 264. Abstr. 56, at "Portland Meeting. Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

The metabolism of radiolabelled Temik® and toxic Temik metabolites in cotton plants was studied. Studies of the fate of Temik in three types of soil was also investigated. (Abstr.)

835 Matsumura, F., Ward, C.T. DEGRADATION OF INSECTICIDES BY THE HUMAN AND THE RAT LIVER. Archs envir. Hlth 13 (1966) 257-261.

Ring ^{3}H-labelled carbaryl, naphthyl-1-^{14}C carbaryl, and ^{14}C-malathion were used. The results of a survey on the human and rat liver capacity to degrade these three insecticides indicated that (1) the general degradation patterns of the livers from these two different species are very similar, (2) aging at room temperature and freeze-storing had some denaturation (or deactivation) effects upon malathion phosphatases and, to a less extent, upon carbaryl oxidative degradation enzymes, (3) malathion carboxyesterases and parathion phosphatases seem to be very stable enzymes against the above treatments, and (4) no detectable evidence to suggest a relationship between the enzyme activities toward these substrate insecticides and the age, sex, the cause of death, postmortem period

(aging), and freeze-storing period of each liver sample: except for one case with carbaryl, where the liver samples from male patients showed a higher rate of water-soluble metabolite production as compared with those from female patients.

836 Metcalf, R.L., Fukuto, T.R., Collins, C., Borck, K., Burk, J., Reynolds, H.T., Osman, M.F. METABOLISM OF 2-METHYL-2-(METHYLTHIO)PROPIONALDEHYDE O-(METHYLCARBAMOYL)-OXIME IN PLANT AND INSECT. J. agric. Fd Chem. 14, 6 (1966) 579-584.

Temik, (registered trademark for Union Carbide 21149) has a structure resembling acetyl choline. The metabolism of the systemic insecticide Temik has been investigated in the cotton plant and in the housefly using ^{14}C-labelled radiotracers and column and thin layer chromatography. Temik is readily and completely oxidized to its sulfoxide within 4-9 d in cotton leaves at moderate temperatures. The sulfoxide which is more active as a cholinesterase inhibitor is the active metabolite and its long term persistence and relatively slow oxidation to Temik sulfone is responsible for the persistent systemic activity of the compound. Temik sulfoxide is hydrolysed to the oxime which is the principal degradation product in the cotton plant. Metabolism in the housefly followed a completely similar pattern.

837 Metcalf, R.L., Osman, M.F., Fukuto, T.R. METABOLISM OF C^{14}-LABELED CARBAMATE INSECTICIDES TO $C^{14}O_2$ IN THE HOUSE FLY. J. econ. Ent. 60, 2 (1967) 445-450.

The absorption, metabolism to $^{14}CO_2$, and excretion by several strains of houseflies, Musca domestica L., were evaluated for nine insecticidal carbamates labelled with ^{14}C in various parts of the molecule. Ring, N-$^{14}CH_3$-, and ^{14}C=O-labelled Banol® (6-chloro-3,4-xylyl methylcarbamate), ^{14}C=O- and N-$^{14}CH_3$-labelled Mesurol® (4-(methylthio)-3,5-xylyl methylcarbamate), and Matacil® (4-dimethylamino)-m-tolyl methylcarbamate), tert-^{14}C-, N-$^{14}CH_3$-, and $^{14}CH_3S$-labelled Temik® (2-methyl-2-(methylthio) propionaldehyde O-(methylcarbamoyl) oxime), o-isoprop-1,3-^{14}C-oxy-labelled Baygon® (o-isopropoxyphenyl methylcarbamate) were used. The absorption and metabolism to $^{14}CO_2$ was not appreciably different in a susceptible and in two carbamate-resistant strains of flies. However, the rate of conversion of the various labelled carbamates to $^{14}CO_2$ was highly specific for the individual carbamates and for the position of labelling. Detoxication of the carbamates was demonstrated to occur through N-dealkylation, S-dealkylation, O-dealkylation, and hydrolysis. The synergists piperonyl butoxide, 2-(3,5-dichlorobiphenyloxy)-triethylamine, and isobornylthiocyano acetate materially decreased the rate of formation of $^{14}CO_2$ from the isopropoxy side chain of 2-isopropoxyphenyl N-methylcarbamate.

838 Mostafa, I.Y., Hassan, A., Zayed, S.M.A.D. METABOLISM OF CARBAMATE DRUGS. III. TRANSLOCATION AND DEGRADATION OF ^{14}C-LABELLED SEVIN IN COTTON PLANTS. Z. Naturf. 21 b (1966) 1060-1062. (In English)

The distribution and metabolic fate of Sevin (1-naphthyl-N-methyl carbamate) in cotton plants (Gossypium barbadense) was investigated using ^{14}C-insecticide labelled at two different sites. Sevin I (specific activity 1.7×10^5 cpm/mg) was prepared by dilution of 0.5 mCi 1-naphthyl-N-methyl (carbamate-^{14}C) with non-radioactive pure Sevin, m.p. 142°C, and Sevin II from 1-naphthyl chloroformate and ^{14}C-methylamine hydrochloride, with an activity of 1.0×10^5 cpm·mg. Sevin was readily absorbed by the root system. Hydrolytic and non-hydrolytic mechanisms contribute almost equally to the metabolism of the insecticide. A specific esterase hydrolyses the ester bond to produce 1-naphthol, methylamine and CO_2 (24% of the absorbed dose). The liberated methylamine undergoes partly a process of oxidative degradation to CO_2. A major metabolite possessing the skeleton CO-C(O)-N-C is probably produced by hydroxylation of the naphthalene ring.

839 Oonnithan, E.S., Casida, J.E. METABOLITES OF METHYL- AND DIMETHYLCARBAMATE INSECTICIDE CHEMICALS AS FORMED BY RAT LIVER MICROSOMES. Bull. exp. Contam. Toxic. 1, 2 (1966) 56-69.

A series of experiments were made with each of ten carbamate-carbonyl-^{14}C-labelled methyl- and dimethylcarbamates to determine their metabolic fate in a system containing rat liver microsomes and reduced nicotinamide adenine dinucleotide phosphate ($NADPH_2$). With emphasis on those with a carbamate structure, the ether-extractable metabolites were separated by thin-layer chromatography (TLC) and the radioactive spots were located by radioautography. The anti-

cholinesterase activity of the metabolites derived from five methylcarbamates was determined, in situ, on the TLC plates. (Auth.)

840 Sacher, R.M., Metcalf, R.L., Fukuto, T.R. SELECTIVITY OF CARBARYL-2,3-METHYLENEDIOXYNAPTHALENE COMBINATIONS. Bull. ent. Soc. Am. 13, 3 (1967) 189. Abstr. 32, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

2,3-methylenedioxynapthalene is an extremely effective synergist for carbaryl in house flies, yet the insecticide-synergist combination is inactive against mammals. The metabolic pathway of ^{14}C and ^{3}H-labelled synergists was studied in both insects and mammals with relation to the selectivity and the mechanism of synergistic action. (Abstr.)

841 Schonbrod, R.D., Wellman, D., Terriere, L.C. THE METABOLISM OF MCA-600 (4-BENZOTHIENYL-N-METHYL CARBAMATE) BY HOUSE FLIES AND HOUSE FLY MICROSOMES. Bull. ent. Soc. Am. 12 (1966) 262. Abstr. 53, at "Portland Meeting. Portland, Oreg., USA. 28 Nov.- 1 Dec. 1966".

In vivo and in vitro experiments were used to study the metabolism of ^{14}C-labelled MCA-600 and the phenolic constituent, 4-HBT. At least four metabolites are produced by either route, but microsomes give relatively larger quantities of one metabolite. Hydrolysis is not a major pathway, but the phenol readily forms the glucoside. (Abstr.)

842 Sullivan, L.J., Eldridge, J.M., Knaak, J.B. DETERMINATION OF CARBARYL AND SOME OTHER CARBAMATES BY GAS CHROMATOGRAPHY. J. agric. Fd Chem. 15, 5 (1967) 927-930.

A method for preparing derivatives of some aryl carbamates to provide stable compounds for gas chromatography entails initial reaction at 4°C between the carbamate and acetic anhydride. The reaction is completed at 97°C over a 30-min-period. Both temperature-programmed and isothermal results using a hydrogen flame detector are given. ^{14}C detection was used for verification of results. Reaction conditions were studied using 1-naphthyl ^{14}C-carbaryl.

843 Tsukamoto, M., Casida, J.E. ALBUMIN ENHANCEMENT OF OXIDATIVE METABOLISM OF METHYLCARBAMATE INSECTICIDE CHEMICALS BY THE HOUSE FLY MICROSOME-NADPH$_2$ SYSTEM. J. econ. Ent. 60, 2 (1967) 617-619.

Activity enhancement and enzyme stabilization by bovine serum albumen (BSA) appear to result from minimizing the influence of inhibitory materials, possibly binding them. Five carbonyl-^{14}C-labelled substrates were used; Baygon® (o-isopropoxyphenyl methylcarbamate), carbaryl, Matacil® (4-(dimethylamino)-m-tolyl methylcarbamate), Mesurol® (4-(methylthio)-3,5-xylyl methylcarbamate), and UC-10854 (m-isopropylphenyl methylcarbamate). 2-Isoprop-^{14}C-oxyphenyl methylcarbamate was used to examine the possibility of Baygon hydrolysis. In this investigation, unless stated otherwise, the substrate was Baygon-carbonyl-^{14}C and the flies were of the Hokota resistant strain, this strain providing the most active enzyme source. Baygon metabolism by the fly abdomen-enzyme system is characterized by the formation of three major metabolites which are listed in the order of their decreasing amounts: 2-isopropoxy-5-hydroxyphenyl methylcarbamate, 2-hydroxyphenyl methylcarbamate, and 2-isopropoxyphenyl N-hydroxymethylcarbamate. Metabolism of carbaryl, Matacil, and Mesurol is also increased by BSA; so, reactions of carbamate insecticide chemicals enhanced by BSA include, in addition to the O-dealkylation observed with Baygon, those involving conversions of aromatic groups to hydroxyaryl and dihydrodihydroxy compounds (carbaryl), of N-methyl substituents to N-hydroxymethyl (carbaryl and Matacil), N-formamido, and N-demethylated groups (Matacil), and of sulfides to sulfoxides (Mesurol) (see ref. 844). BSA also enhances alkyl side chain hydroxylation of UC 10854 to give 3-(2-hydroxy-2-propyl) phenyl methylcarbamate. Albumin is known to catalyze carbaryl hydrolysis; although BSA does not act in this manner with Baygon, it may catalyze hydrolysis of carbaryl, Matacil, and Mesurol, and/or their oxidation products.

844 Tsukamoto, M., Casida, J.E. METABOLISM OF METHYLCARBAMATE INSECTICIDES BY THE NADPH$_2$-REQUIRING ENZYME SYSTEM FROM HOUSE FLIES. Nature, Lond. 213 (1967) 49-51.

Certain resistant strains of houseflies are distinguished from susceptible strains by greater enzyme activity for the oxidation of several insecticide chemicals. This may contribute to the mechanism of resistance. Abdomens are a convenient source of this enzyme. The following carbamates labelled with ^{14}C were used as substrates for the enzyme system: 'Baygon' (2-isopropoxyphenyl methylcarbamate); carbaryl (1-naphthylmethylcarbamate), UC 10854 (3-isopropylphenyl methylcarbamate); HRS-1422 (3,5-diisopropylphenyl methylcarbamate); 'Banol' (2-chloro-4,5-xylyl methylcarbamate); 'Mesurol' (4-methylthio-3,5-xylyl methylcarbamate); 'Matacil' (4-dimethylamino-3-cresyl methylcarbamate); 'Zectran' (4-dimethylamino-3,5-xylyl methylcarbamate); 'Isolan' (1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate); dimetilan (1-dimethylcarbamoyl-2-methyl-4-pyrazolyl dimethylcarbamate). In most of the experiments, 'Baygon' and 'Matacil' labelled with ^{14}C were used. Homogenates of the whole body of any six housefly strains in the presence or absence of $NADPH_2$ did not extensively metabolise ^{14}C-labelled Baygon, but the abdomen homogenates of these insects were much more active than homogenates of the head, thorax, or whole body in the presence of $NADPH_2$. This abdomen activity, almost specific for $NADPH_2$, resided predominantly in the microsomal fraction. The addition of homogenates of the head or thorax, individually or in combination, to the abdomen homogenates markedly reduced the activity of the abdomen $NADPH_2$-requiring enzyme system. The activity of the abdomen homogenate was greater for any of three carbamate-resistant strains than for any three laboratory strains of the housefly. The enzyme activity was higher for adult flies fed milk than it was for those fed sugar and water. Similar results were obtained from nine other methylcarbamate insecticides. As determined by tentative characterization of the methylcarbamate metabolites by autoradiography and thin-layer chromatography, aromatic hydroxylation occurred at either the 4- or 5-position of carbaryl, and O-dealkylation occurred with Baygon to yield 2-hydroxyphenol methylcarbamate.

845 Winteringham, F.P.W. DILUTION EFFECTS ON THE MEASUREMENT OF BLOOD CHOLINESTERASE INHIBITION BY CARBAMATE. Nature, Lond. 212 (1966) 1368-1369.

Results indicate that the error due to enzyme reactivation after dilution when estimating the inhibition of blood cholinesterase by carbamates by a radiometric method (see III/110 and ref. 846) may be significantly smaller than expected as a result of the nominal 11-times dilution. They also confirm that significant differences exist between nominal and effective inhibitor concentrations when studying enzyme inhibition at high tissue concentrations. Further implications are pointed out.

846 Winteringham, F.P.W., Fowler, K.S. SUBSTRATE AND DILUTION EFFECTS ON THE INHIBITION OF ACETYLCHOLINESTERASE BY CARBAMATES. Biochem. J. 101, 1 (1966) 127-34.

The kinetics of acetylcholinesterase (EC 3.1.1.7) activity and its inhibition by eserine or by Sevin (1-naphthyl N-methylcarbamate) have been studied over the substrate concentration range 5×10^{-8} to 2.5×10^{-2} M. [Carboxy-^{14}C] acetylcholine was used. The anhydrous chloride (0.71 mg of specific activity 6.4 μCi/μM) was dissolved in 7.81 mℓ of water to give 0.50 mM stock solution at pH 4.5 subsequently stored at -15°C. Equations are given for inhibition as a function of time, substrate and inhibitor concentrations, and the relevant parameters determined at 25° and 37°C. The observed and calculated effects of time, dilution, substrate addition and enzyme concentration were in good agreement and consistent with a steady-state carbamylation by eserine or by Sevin in the presence of excess of inhibitor. The quantitative destruction of either inhibitor at high enzyme concentrations implied by the carbamylation hypothesis has been confirmed experimentally. The importance and possibility of allowing quantitatively for dilution and substrate effects when estimating carbamate inhibition are demonstrated.

847 Zayed, S.M.A.D., Hassan, A., Hussein, T.M. METABOLISM OF CARBAMATE DRUGS. II. DEGRADATION OF 1-NAPHTHYL-N-METHYL CARBAMATE (SEVIN) IN ADULT LARVA OF THE COTTON LEAF WORM (Prodenia litura F.). Biochem. Pharmac. 15, 12 (1966) 2057-2064.

The metabolic fate of Sevin has been investigated in the adult larva of P. litura F., using ^{14}C-Sevin, labelled at two different sites. From the topically applied dose, 32-37% was recovered as ^{14}C-metabolites in the excreta and the expired air after 20 h. The insecticide is mainly detoxified by a non-hydrolytic mechanism, probably involving hydroxylation of the aromatic ring. The minor hydrolytic pathway (~14%) involves hydrolysis of the ester bond to give 1-naphthol and N-methyl carbamic acid. The latter decarboxylates to give methylamine which undergoes a process of oxidative demethylation to produce ^{14}C-formate and $^{14}CO_2$. A scheme has been suggested for the oxidative pathway of the methyl group of Sevin. (Auth.)

848 Zubairi, M.Y. DETOXICATION OF DIMETILAN IN COCKROACHES AND HOUSEFLIES. Diss. Abstr. 26, 7 (1966) 3620.

Dimetilan (2-dimethylcarbamoyl-3-methyl-5-pyrazolyl dimethylcarbamate) and Isolan (1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate) have been used in Europe as an aphicide and for control of resistant and non-resistant houseflies, respectively. Dimetilan is of intermediate oral and low dermal toxicity to mammals while Isolan is highly toxic by both routes of administration. Dimetilan was selected for a more intensive study of carbamate insecticide metabolism by insects because it is selectively toxic, and contains within the molecule a variety of sites that might be susceptible to metabolic attack. A study of the chemical nature and biological activity of dimetilan metabolites was therefore undertaken, with dimetilan labelled with ^{14}C on the carbamate ester carbonyl group. Dimetilan was rapidly metabolised following injection into German cockroaches (Blattella germanica L.), American cockroaches (Periplaneta americana L.) and houseflies (Musca domestica L.). Dimetilan was converted in P. americana to metabolites which yielded formaldehyde on acid degradation, and these metabolites increased in amount with increasing time up to 24 h after treatment. This indicated that N-methyl hydroxylation might be a major detoxication mechanism for dimetilan in insects. Nine metabolites of dimetilan-^{14}C were detected in B. germanica, and of these six were also demonstrated in P. americana and four in M. domestica. Most of these metabolites were formed in appreciable amounts within one-half hour after treatment, by which time more than half of the injected dimetilan was metabolised. $^{14}CO_2$ was liberated from B. germanica treated with labelled dimetilan, so hydrolysis was in part involved in the detoxication. Rats treated orally with dimetilan-^{14}C also excreted two of these same metabolites in the urine. Five of these metabolites were recovered in milligram amounts within 2-24 h after injection of dimetilan into large numbers of P. americana adults at 1.0 mg/insect. Metabolites were resolved and purified by preparative scale thin layer chromatography. Three of these metabolites yielded formaldehyde and dimethylamine on acid degradation, one yielded formaldehyde but no dimethylamine, and one yielded dimethylamine but no formaldehyde. All metabolites could be degraded to 3-methyl-5-pyrazolone. The major metabolite from P. americana yielded formaldehyde, dimethylamine, methylamine and 3-methyl-5-pyrazolone on degradation. Based on these analyses and its infrared spectrum, this metabolite might be 2-dimethylcarbamoyl-3-methyl-5-pyrazolyl N-hydroxymethyl, N-methylcarbamate. Another metabolite appeared to be 2-methylcarbamoyl-3-methyl-5-pyrazolyl pyrazolyl dimethylcarbamate based on chromatographic and bioassay comparison with the known compound. None of the metabolites were more toxic to house flies than dimetilan, but one formaldehyde-yielding metabolite was almost as toxic as the parent material. Many metabolites were synergized in their toxicity by sesamex [acetaldehyde 2-(2-ethoxyethoxy)ethyl-3,4-methylenedioxyphenyl acetal] as was also the case with dimetilan and several of its analogues. N-Methyl hydroxylation appears to be a major factor in the detoxication of dimetilan in insects. (From DA)

See also:

610 The relation between physical properties and uptake of insecticides by eggs of the large milkweed bug. (Bracha, P. et al., 1966)

684 The elimination of pesticide residues on apricots by washing before canning. (Viel, G. et al., 1966)

896 Synthesis of methylene-^{14}C-dioxyphenyl compounds: radioactive safrole, dihydrosafrole, myristicin, piperonyl butoxide, and diastereoisomers of sulfoxide. (Kuwatsuka, S. et al., 1965)

897 Mode of action of insecticide synergists. (Metcalf, R.L., 1967)

1.5.6. Pyrethroids

849 Barthel, W.F. SYNTHETIC PYRETHROIDS. Adv. Pest Control Res. 4 (1961) 33-74.

Metabolism of labelled pyrethrins (dl-cis-trans-allethrings-2-^{14}C) was studied by treating houseflies topically and resolving the metabolic products chromatographically at the end of a 24-h incubation period. It was found that the radioactive preparations were metabolised to non-insecticidal substances within 24 h.

850 Crombie, L., Elliott, M. CHEMISTRY OF THE NATURAL PYRETHRINS. Fortschr. Chem. org. NatStoffe 19 (1961) 120-164.

In this comprehensive review of the chemistry of natural pyrethrins valued for their insecticidal properties, some of these are studied by means of radio-tracing technique, and others are produced as labelled compounds. An example of the latter is allethrin labelled with ^{14}C in ketol or acid portion used for biological studies; whereas pyrethrins and cinerines are studied by means of ^{14}C labelling of (±)2-^{14}C-mevalonic acid which is incorporated into the two chrysanthemic acids when fed to the achenes of pyrethrum flowers, and thus supports the isoprenoid derivation. (Battelle Institute Card File)

851 Fine, B.C., Godin, P.J., Thain, E.M., Marks, T.B. RESISTANCE TO PYRETHRINS AND DDT IN A STRAIN OF HOUSEFLIES Musca domestica L. 1. THE SORPTION OF A SYNTHETIC [^{14}C] PYRETHRIN I. J. Sci. Fd Agric. 18, 5 (1967) 220-224.

A [^{14}C] pyrethrin I mixture, consisting of a mixture of the naturally occurring ester and one of its diastereoisomers, was synthesised, via 2-[^{14}C] ethyl aminoacetate hydrochloride, 2-[^{14}C] ethyl diazoacetate, (±)-2-[^{14}C] trans-chrysanthemum-monocarboxylic acid, (±)-2-[^{14}C] trans-chrysanthemoyl chloride. Penetration of the labelled material in a strain of houseflies that had shown resistance to pyrethroids in the field was studied. It could be shown that the resistance of the flies, which also show a high degree of tolerance to DDT, is due in part to reduced penetrations of the pyrethrin I.

852 Yamamoto, I., Casida, J.E. O-DEMETHYL PYRETHRIN II ANALOGS FROM OXIDATION OF PYRETHRIN I, ALLETHRIN, DIMETHRIN, AND PHTHALTHRIN BY A HOUSE FLY ENZYME SYSTEM. J. econ. Ent. 59, 6 (1966) 1542-1543.

In order to investigate pyrethroid metabolism it was necessary to prepare ^{14}C-labelled pyrethroids which were stereochemically pure and of high specific activity, and to develop adequate chromatographic procedures to resolve closely related metabolites or degradation products, and an in vitro enzyme system active in pyrethroid metabolism. d-trans-Chrysanthemumic acid-1-^{14}C was esterified with d-pyrethrolone to yield pyrethrin I-^{14}C, with d-allethrolone to yield allethrin-^{14}C, with 2,4-dimethylbenzyl alcohol to yield dimethrin-^{14}C, and with N-hydroxymethyl-3,4,5,6-tetrahydrophthalimide to yield phthalthrin-^{14}C. Allethrin-alcohol-^{14}C, from labelled dl-allethrolone, and phthalthrin-N-methylene-^{14}C were also prepared. Thin-layer chromatography on silica gel G was used in one or two dimensions.
Labelled compounds were detected by autoradiography, and phosphomolybdic acid was used as the chromogenic reagent for detecting known, unlabelled compounds in cochromatography studies. For in vitro enzyme studies, the Musca domestica abdomen system fortified with nicotinamide adenine dinucleotide phosphate, reduced form ($NADPH_2$), and the Hokota-resistant and SCR-susceptible fly strains were used. With this system and allethrin-^{14}C as the substrate, metabolism by an unfractionated homogenate of whole abdomens or by the microsome fraction from such a homogenate was $NADPH_2$-dependent and more extensive with the Hokota- than the SCR-strain; accordingly, homogenates of whole abdomens from the Hokota-strain and fortification with $NADPH_2$ were used for routine studies.
Allethrin-^{14}C was converted to 13 metabolites, each with its ester group intact. The major metabolite proved to be O-demethyl allethrin II. Results indicate that pyrethrin I, dimethrin, and phthalthrin are metabolised by the in vitro enzyme systems by oxidation of the analogous methyl group and that other modifications of the molecule are not involved in forming the major metabolites. Pyrethrin I-^{14}C was converted in vitro to at least ten metabolites and the major metabolites differed only slightly in chromatographic positions from those derived from allethrin-^{14}C. Preliminary studies indicate that allethrin is also converted in part to O-demethyl allethrin II in vivo. This reaction involves a detoxification because allethrin is 30fold more toxic than O-demethyl allethrin when these compounds are injected into house flies.

1.5.7. Nicotine Alkaloids (including Anabasine and Related Compounds)

853 Decker, K., Sammeck, R. ENZYMCHEMISCHE UNTERSUCHUNGEN ZUM NIKOTINABBAU IN DER KANINCHENLEBER. (Chemical study, by means of enzymes, of nicotine degradation in rabbit liver.) Biochem. Z. 340 (1964) 326-336. (In German, with English summary)

The degradation pathway for methyl-labelled nicotine and ring-labelled nicotine has been studied. By comparison it has been found that cotinine and nornicotine are formed in vivo as well as by the cell-free fractions of the rabbit liver. In the latter system 10-20% of the total nicotine degradation goes via nornicotine, which then is partly dehydrogenated yielding norcotinine. No demethylation of cotinine has been observed. The formation of nornicotine is accompanied by a liberation of free formaldehyde, which then subsequently is oxidized by the liver fraction yielding CO_2. A chemical synthesis of DL-[2'-^{14}C] nicotine is described. (Auth.)

854 Decker, K. THE RADIOCHEMICAL SYNTHESIS OF SPECIFICALLY LABELED NICOTINE MOLECULES. p.39-44 of "Proceedings of the Symposium on the Preparation and Bio-Medical Application of Labeled Molecules. Venice, Italy, 28-29 Aug.1964". Sirchis, J., Ed. Brussels, EURATOM. Dec.1964, 500p. EUR 2200.e, European Atomic Energy Community, Brussels (Belgium).

The structural features of the molecule allow several catabolic pathways which lead to different intermediates and endproducts. The elucidation of these reaction sequences was greatly facilitated by the use of nicotine preparations labelled in different positions. Radioactive nicotine was synthesised ^{14}C-labelled either in C-2' of the pyrolidine ring or in the N'-methyl group. The preparation of the ring-labelled compound 2'-^{14}C-DL-nicotine required additional synthetic steps; [7-^{14}C]-nicotinic acid was prepared from $^{14}CO_2$ and pyridine lithium. The analytical data are tabulated, and the chemical and radiochemical homogeneity and purity of the substances is shown.

855 Decker, K., Sammeck, R. METABOLIC STUDIES WITH SPECIFICALLY LABELED NICOTINE MOLECULES. p.165-172 of "Proceedings of the Symposium on the Preparation and Bio-Medical Application of Labeled Molecules. Venice, Italy, 23-29 Aug.1964". Sirchis, J., Ed. Brussels, EURATOM. Dec.64, 500p. EUR 2200.e, European Atomic Energy Community, Brussels (Belgium).

$^{14}CH_3$-L-nicotine and 2'-^{14}C-DL-nicotine were used, in order to obtain qualitative as well as quantitative data on the catabolic routes of the base and intermediates of these pathways. Nicotine degradation by cell-free extracts of nicotine-adapted Arthobacter oxidans was studied, in order to elucidate intermediates. The degradation product was identified as γ-methylamino butyric acid. Nornicotine was found to be a metabolite of nicotine in rabbit liver. This pathway, which included further oxidation of part of the nornicotine to norcotinine amounts to some 20% of the total nicotine catabolism. Cotinine was not demethylated. The fate of N'-methyl group was elucidated using $^{14}CH_3$-nicotine. Transmethylation and an intermediate formation of hydroxymethyl tetrahydrofolate appeared to be ruled out. Liver enzymes proved equally active with both L- and D-nicotine.

856 Fleeker, J.R. THE ROLE OF GLYCEROL IN THE BIOSYNTHESIS OF THE PYRIDINE RING OF NICOTINE. Diss. Abstr. 26, 8 (1966) 4207.

The purpose of this study was to determine where the carbon atoms of glycerol were incorporated into the pyridine moiety of nicotine. Glycerol-1,3-^{14}C and glycerol-2-^{14}C were employed as precursors and were fed hydroponically to newly grown roots of intact Nicotiana rustica. The nicotine produced was isolated as the dipicrate. Nicotine was oxidized to nicotinic acid which was then converted to 2-hydroxynicotinic acid via several intermediates. The 2-hydroxynicotinic acid was decarboxylated and the resulting 2-hydroxypyridine reduced to valerolactam. The lactam was hydrolysed, then methylated to the betaine which was heated in KOH at 350°C for 10 min. The acetic and propionic acids which resulted from this cleavage were degraded carbon by carbon and the carbon dioxide collected and counted. When nicotinic acid-4,6-^{14}C was degraded in this manner, all the radioactivity was found in the propionic acid, thus the cleavage of the betaine is between the 3 and 4 carbons of the pyridine ring. Glycerol-1,3-^{14}C labelled the pyridine ring at the 4 and 6 positions, with a significant amount of activity in the 2 and 3 carbon atoms. Glycerol-2-^{14}C labelled the ring almost exclusively in carbon atom 5. The results of this study are discussed and compared to the results of other studies on compounds containing the pyridine moiety. (DA)

857 Il'in, G.S. THE BIOCHEMISTRY OF TOBACCO ALKALOIDS. Izv. Akad. Nauk SSSR, Ser. Biol. No. 6 (1967) 835-842. (In Russian, with English and French summaries)

The biosynthesis of nicotine, (its mechanism, sites, and the influence of the stage of development on its formation) and nicotine metabolism were studied by means of nicotine labelled via $NaH^{14}CO_3$.

858 Jackanicz, T.M. THE INCORPORATION OF ASPARTATE AND MALATE INTO THE PYRIDINE RING OF NICOTINE. Diss. Abstr. 26, 8 (1966) 4211.

In an attempt to study the incorporation of dicarboxylic acids which might be used for pyridine ring biosynthesis, aspartic and malic acids were employed as possible precursors. Although procedures have been developed previously for the degradation of the pyridine ring, in the present study a method for the isolation of each carbon of the ring was devised which required fewer steps and resulted in a greater over-all yield than was the previous case. Therefore much less nicotine was required in each degradative study. Aspartate-3-^{14}C and malate-3-^{14}C were hydroponically fed to Nicotiana rustica plants. The nicotine was isolated as the dipicrate, converted to the hydrochloride, and oxidized to nicotinic acid. The nicotinic acid was methylated to trigonelline acid sulfate which was oxidized to N-methyl-2-pyridone-5-carboxylic acid. Decarboxylation of the pyridone-carboxylic acid and catalytic reduction of the ensuing product produced N-methyl-2-piperidone. Hydrolysis of the piperidone, subsequent methylation to the betaine, followed by potassium hydroxide fusion, yielded acetic acid from carbons 5 and 6 of the original pyridine ring, and propionic acid from carbons 2, 3, and 4. The over-all yield of the fatty acids from nicotine was about 15%. Therefore, about 2 g of nicotine was ample starting material for each degradation. When aspartic acid-3-^{14}C was studied, 57% of the label resided in carbon 3 of the pyridine ring, whereas 38% was in carbon 2. When malic acid-3-^{14}C was employed, 61% of the tracer appeared in carbon 3, whereas 38% was in carbon 2. The remaining small percentage of radioactive carbon was scattered among the other carbon atoms. (From DA)

859 Jackanicz, T.M., Byerrum, R.U. INCORPORATION OF ASPARTATE AND MALATE INTO THE PYRIDINE RING OF NICOTINE. J. biol. Chem. 241, 6 (1966) 1296-1299.

A unique nicotinic acid degradation was devised which permitted the isolation of each individual C atom of the pyridine ring. Aspartate-3-^{14}C and malate-3-^{14}C were administered to Nicotiana rustica tobacco plants for 4 h and were incorporated almost exclusively into carbons 2 and 3 of the pyridine ring of nicotine. When aspartate-3-^{14}C was used, 57% of the tracer resided at C-3 and 38% at C-2. Malate-3-^{14}C labelled C-3 with 61% of the isotope and C-2 with 38%. The dilution of incorporation of aspartate-3-^{14}C was 600 and of malate-3-^{14}C, 1200. The incorporation of aspartate and malate with low dilution and the lack of randomization of ^{14}C between C-2 and -3 of the pyridine ring indicate either that aspartate or malate is the immediate precursor of the pyridine ring of nicotine, or that they are converted to the immediate precursor without passing through a symmetrical intermediate. (CA 64:1966, 13106 ef)

860 Kisaki, T., Tamaki, E. PHYTOCHEMICAL STUDIES ON TOBACCO ALKALOIDS. PART IV. STEREOSPECIFIC DEMETHYLATION OF NICOTINE IN TOBACCO LEAVES. Agric. biol. Chem., Tokyo 28, 7 (1964) 492.

The preparation of radioactive nicotine is described. From the findings of the feeding experiments of d- and l-nicotine-$^{14}CH_3$ and d-nicotine to the excised tobacco leaves, it was demonstrated that demethylation of nicotine was stereospecific for the d-form in tobacco leaves. Such preferential demethylation to the enantiomer was also observed with N-methylanabasine and 1-(3'-pyridyl)-1-methylaminoethane which are analogous compounds to nicotine.

861 Liebman, A.A., Mundy, B.P., Rapoport, H. THE BIOSYNTHESIS OF NICOTINE IN Nicotiana glutinosa FROM CARBON-14 DIOXIDE. LABELING PATTERN IN THE PYRROLIDINE RINGS. J. Am. chem. Soc. 89, 3 (1967) 664-672.

A systematic degradation has been developed which permits isolation of each carbon atom of the pyrrolidine ring of nicotine. The independent synthesis of specifically labelled intermediates obtained during this sequence and their degradation have confirmed the integrity of the entire process. This degradation has been applied to numerous samples of nicotine obtained from short-term $^{14}CO_2$ biosynthesis with N. glutinosa, and in each experiment the pyrrolidine ring showed an

unsymmetrical labelling pattern, a condition contrary to the accepted symmetrical intermediate hypothesis of pyrrolidine ring formation. Ornithine feeding experiments, from which the symmetrical theory had evolved, were applied to N. glutinosa and results were identical with those in other species. These experiments establish a greatly different labelling pattern in the pyrrolidine ring from CO_2 than from preformed precursors such as ornithine. (Auth.)

862 Lovkova, M.Y. BIOSYNTHESIS OF NICOTINE. Izv.Akad.Nauk.SSSR, Ser.Biol.No.3 (1967) 413-421. (In Russian, with English summary)

The literature on nicotine biosynthesis is reviewed, as are studies of the biosynthesis of the pyridine and pyrollidine cycles of the nicotine molecule and the formation of the methyl group of nicotine. Radioactive labelled compounds used in these studies include ^{14}C-labelled succinate, glycerine, ornithine-2-^{14}C, ^{3}H-labelled nicotinic acid, and others. Some of her own work is mentioned. 55 papers are reviewed.

863 Makky, A.M.M. RADIOACTIVE NICOTINE: BIOSYNTHESIS, TOXICITY AND METABOLISM. Diss.Abstr. 27, 3 (1966) 724-B.

Carbamate groups attached to the 2- or 6-position of nicotine (Carbamic acid, dimethyl-, 3-(1-methyl-2-pyrrolidinyl)-2-pyridyl ester and Carbamic acid, dimethyl-, 5-(1-methyl-2-pyrrolidinyl) -2-pyridyl ester) were synthesised. These groups did not increase nicotine toxicity when the compounds were applied to mosquito larvae. However, the compound of nicotine with the carbamate in the 2-position (Carbamic acid, dimethyl-, 3-(1-methyl-2-pyrrolidinyl)-2-pyridyl ester) was very toxic to mice, and its toxicity was at least ten times that of nicotine. Radioactive nicotinic acid (nicotinic acid 2-^{3}H) was synthesised and fed to Nicotiana tabacum plants to obtain radioactive nicotine (nicotine 2-^{3}H) biosynthetically. The toxic effects of both radioactive and natural nicotine were evaluated on mosquito larvae Aedes aegypti. Also, the effects of larval population density on radioactive and natural nicotine were studied. It was concluded that there was a significant difference caused by differences in population density, excessive population density (400 larvae/100 ml water) decreased natural nicotine toxicity. In case of radioactive nicotine, however, the population density showed no effect on toxicity. On the other hand, radioactive nicotine was found to be significantly more toxic to the larvae than natural nicotine. These results showed a great deal of evidence that C-2 of nicotine which was labelled with ^{3}H is involved in nicotine metabolism. This involvement of the pyridine ring in nicotine metabolism by higher animals is a novel hypothesis. It had never been known before that the pyridine ring of nicotine interferes in nicotine metabolism by higher animals (Vertebrates or Invertebrates). (DA)

864 McKennis, J., Jr., Turnbull, S.B., Schwartz, J.L., Tamaki, E., Bowman, E.R. DEMETHYLATION IN THE METABOLISM OF (—)-NICOTINE. J.biol.Chem. 237, 2 (1962) 541-546.

The metabolism of (—)-nicotine-methyl-^{14}C has been studied in both the rat and the dog. After administration to the former species, 6-10% of the radioactivity of the dose appeared as respiratory carbon dioxide. An examination of the metabolism of (—)-nicotine and the intermediate (—)-cotinine in both species leads to the conclusion that the conversion of cotinine to demethylcotinine is involved in the formation of carbon dioxide-^{14}C. After administration of nicotine-methyl-^{14}C, cotinine and γ-(3-pyridyl)-β-oxo-N-methylbutyramide were isolated from the urine of dogs. All of the radioactivity of the latter compound was found in the N-methyl group. As a consequence of this and other considerations, methylamine arising from the hydrolysis of the keto amide in vivo may be an intermediate in the formation of the carbon dioxide-^{14}C observed in the studies. (Auth. summary)

865 Scott, T.A., Glynn, J.P. THE INCORPORATION OF [2,3,7-^{14}C] NICOTINIC-ACID INTO NICOTINE BY Nicotiana tabacum. Phytochemistry 6, 4 (1967) 505-510.

[2,3,7-^{14}C] Nicotinic acid, prepared from [U-^{14}C] aniline hydrogen sulphate, was administered to tobacco plants via the roots in hydroponic culture. Radioactive nicotine was isolated from the plant and purified as the dipicrate. The dipicrate was converted into nicotine, which was oxidized to nicotinic acid. The nicotinic acid was degraded stepwise to give the radioactivity of each carbon atom. A feature of this degradation is the rapid hydrogenation of nicotinic acid with rhodium on charcoal as the catalyst; there is a 50% simultaneous decarboxylation to give hexahydronicotinic acid, piperidine and CO_2. Radioactivity was detected and measured in positions 2 and 3 of the nicotinic acid, with negligible activity in positions 4, 5 and 6. This shows that the pyridine ring of nicotinic acid does not

become symmetrical during its conversion into nicotine; the attachment of the pyrrolidine moiety occurs only at the site from which the carboxylic acid group is lost, i.e. at position 3. (Auth.)

866 Weiss, G.B. THE EFFECT OF pH ON NICOTINE-INDUCED CONTRACTURE AND ^{45}Ca MOVEMENTS IN FROG SARTORIUS MUSCLE. J. Pharmacol. exp. Ther. 154 (1966) 605-612.

The contracture and three-fold increase in ^{45}Ca uptake induced by 2.5 mM nicotine in frog sartorius muscle could be inhibited by lowering the pH of the Ringer's bathing solution from 8.4-7.4. The nicotine-induced contracture and ^{45}Ca efflux obtained at pH 8.4 after prolonged washout in Ca-free Ringer's solution containing 4 mM EDTA were also inhibited by decreasing the pH to 7.4. If the amount of nicotine in pH 7.4 Ringer's solution was raised to 10 mM, the concentration of non-ionized nicotine was equal to that present in pH 8.4 Ringer's solution containing 2.5 mM nicotine. The contracture and increased ^{45}Ca uptake induced by 10 mM nicotine in the pH 7.4 Ringer's solution did not differ significantly from that obtained using pH 8.4 Ringer's solution containing 2.5 mM nicotine. The uptake of ^{14}C-labelled nicotine into frog sartorius muscles was more than doubled by increasing the pH of the Ringer's solution from 7.4 - 8.4. These observations indicated that the magnitude of the nicotine-induced contracture and ^{45}Ca movements is dependent upon the concentration of non-ionized nicotine in the bathing solution. Thus, the non-ionized form of nicotine appeared to be the molecule of importance not only for penetration of the cell membrane, but for alterations in ^{45}Ca movements and contracture tension in frog sartorius muscle. (NSA 22;1968, 6738)

867 Yasumatsu, N., Sakurai, A., Tamura, S. STUDIES ON THE CHEMICAL REGULATION OF ALKALOID BIOSYNTHESIS IN TOBACCO PLANTS. I. INHIBITION OF NICOTINE BIOSYNTHESIS BY HELMINTHOSPOROL AND HELMINTHOSPORIC ACID. Agric. biol. Chem., Tokyo 31, 9 (1967) 1961-1965. (In Japanese, with English summary)

A tobacco plant, Nicotiana tabacum, cut off at the 16th leaf, with roots removed, was treated with ^{14}C-ornithine, ^{14}C-glutamic acid, ^{3}H-nicotinic acid, helminthosporal, and helminthosporic acid. The biosynthesis of nicotine was studied, also the inhibiting effect of helminthosporal and helminthosproic acid.

868 Yoshida, D. RELATIONSHIPS BETWEEN THE TRANSLOCATION OF PHOTOSYNTHETIC PRODUCTS AND THE NICOTINE SYNTHESIS IN TOBACCO PLANTS. Soil Pl. Fd, Tokyo 13, 3 (1967) 63-70. (In Japanese, with English summary)

Nicotine synthesis and the translocation of photosynthetic products were studied in Nicotiana tabacum, the output of radioactive CO_2 ($^{14}CO_2$) being measured.

869 Yoshida, D. EFFECTS OF NUTRIENT DEFICIENCIES ON THE BIOSYNTHESIS OF NICOTINE IN TOBACCO PLANTS. Soil Pl. Fd, Tokyo 13, 4 (1967) 107-112. (In Japanese, with English summary)

^{14}C-labelled glutamic acid, ornithine, arginine and putrescine, and ^{3}H-labelled agmatine and nicotinic acid were used in studying the effect of nutrient deficiencies on the biosynthesis of nicotine in tobacco plants (Nicotiana tabacum). The nutrient solution used was either normal or deficient in Mg, N, P, K, Ca, S or B.

1.5.8. Rotenoids

870 Fukami, J., Yamamoto, I., Casida, J.E. METABOLISM OF ROTENONE IN VITRO BY TISSUE HOMOGENATES FROM MAMMALS AND INSECTS. Science, N.Y. 155 (1967) 713-716.

Hydroxylation of rotenone in vitro in the enzyme system composed of microsomes and reduced nicotinamide-adenine dinucleotide phosphate, and in living mice and houseflies, yields products tentatively identified as rotenolone I; rotenolone II; 8-hydroxyrotenone, 6',7'-dihydro-6',7'-dihydroxyrotenone; two rotenolones of each of the last-mentioned two compounds; and uncharacterized polar material. The toxicity of certain of these rotenoids to mice is of the same order as that of rotenone. Rotenone-6a-^{14}C (97% radiochemical purity) was used, and the metabolites resolved by thin-layer chromatography.

871 Horgan, D.J., Singer, T.P. CHARACTERISTICS OF THE BINDING OF ROTENONE IN THE RESPIRATORY CHAIN AND THE INHIBITION SITES OF AMYTAL AND PIERICIDIN A. Biochem.J. 104, 3 (1967) 50C-52C.

The specificity, stoichiometry and reversibility of rotenone binding were investigated using [^{14}C]-rotenone (2.36 mCi/mM). Although on titration with electron-transport particles with rotenone the inhibition rises in a hyperbolic curve, rotenone binding is quite linear, even though five times as much rotenone is added as that required for max. inhibition. When the titration was performed in the presence of 2% (w/v) bovine serum albumin, however, a biphasic binding curve was obtained, showing a rapid initial rise, corresponding to the specific binding site in the NADH dehydrogenase segment of the chain, and a slower secondary rise, representing binding at other points. Amytal and piericidin A compete with rotenone for the binding site responsible for inhibition by rotenone. The effects of piericidin A and Amytal on the binding of rotenone at the specific site clearly suggest that all three substances react at the same point in the respiratory chain, although not necessarily with the same groups. For the stoichiometry of binding at the specific site it was calculated that ~ 40 mμM of rotenone are bound per gram of protein in electron-transport particles at that point. The amount of rotenone bound at the specific site is of the same order as the NADH dehydrogenase content.

872 Horgan, D.J., Singer, T.P. REACTION SITES OF ROTENONE IN THE RESPIRATORY CHAIN AND IN SOLUBLE DPNH-COENZYME Q REDUCTASE. Biochem.biophys.Res.Commun. 27 (1967) 356.

The experiments reported offer independent evidence that the reaction site of coenzyme Q homologues and of rotenone are not the same in intact particles and in the soluble reductase. Rotenone-6a-^{14}C (2.36 mCi/mM) was used. A diagrammatic flow sheet of the preparation of soluble DPNH-CoQ reductase from ^{14}C-rotenone labelled ETP is given, also a table showing the distribution of enzyme activity and of radioactive rotenone during purification of DPNH dehydrogenase. On solubilization of DPNH dehydrogenase from ^{14}C-rotenone labelled ETP, ~ 9% of the rotenone accompanies 90% of the activity in the extract. On further purification all but a trace of the radioactive rotenone is separated from the dehydrogenase. The absence of CoQ reductase activity in the dehydrogenase obtained by phospholipase A extraction does not appear to be due to the presence of an inhibitor but to the absence of exposure to modifying agents.

1.5.9. Chemosterilants

873 Bořkovec, A.B. INSECT CHEMOSTERILANTS. Adv.Pest Control Res. 7 (1966) 1-114.

This is a compilation of the pertinent information currently available on chemosterilants, with an outline of their development and considered generalizations as to their potential application. The author is concerned primarily with the diverse features of chemosterilant compounds and with their varying effects on different species of insects. However, in out-lining the advantages inherent in the use of chemosterilants, including the economically important aspects, he presents chapters on the theoretical basis of the insect-sterility control method and on the testing and practical application of insect chemosterilants. The very comprehensive bibliography is complete up to July 1966. The book includes chapters on the chemistry of insect sterilants (alkylating agents, antimetabolites, miscellaneous agents), the physiological effects (in female and male insects, and other organisms) and their testing and practical application. A number of studies on chemosterilants are mentioned in which radioisotopes were used (e.g. ^{32}P-metepa, ^{14}C-tepa) or the effectiveness of sterilization by chemosterilants and ionizing radiations is compared.

874 Chang, S.C. METABOLIC STUDY OF C ^{14}-HEMPA IN MALE HOUSE FLIES. Bull.ent.Soc.Am. 12 (1966) 286. Abstr.101, at "Portland Meeting. Portland, Oreg., USA. 28 Nov.-1 Dec.1966".

Uniformly labelled ^{14}C-hempa with a specific activity of 98 mCi/mM was used in the study of the rate of sterilisation action in vivo, the rate of disappearance from flies, and the rate of recovery from fly excreta. The isolation and identification of a metabolite was discussed. (From abstr.)

875 Chang, S.C., Bořkovec, A.B., Woods, C.W. FATE OF TEPA UNIFORMLY LABELED WITH C^{14} IN MALE HOUSE FLIES. J.econ.Ent. 59, 4 (1966) 937-944.

Tepa uniformly labelled with ^{14}C with a specific activity of 12 mCi/mM was used to study the metabolism and mechanism of sterilization in male house flies, Musca domestica L. A wet-combustion

method was developed for ^{14}C-labelled compounds which gave quantitative recovery and reproducible results. The injection of ^{14}C-labelled tepa was adjusted to about 1 µg/male fly. Total recovery of radioactivity from treated flies and their excreta was almost quantitative; radioactivity in respiratory CO_2 was only 0.75% of the injected dose during the first 12 h. When male flies were allowed normal activities after an injection of about 1 µg of ^{14}C-labelled tepa, 50% of the dose was retained in the fly 5 h after treatment. Radioactivity was present in treated flies as tepa or aziridinyl metabolites; radioactive metabolites in the excreta did not contain aziridinyl groups. Radiometric and colorimetric determinations indicated that treated flies retained about 9 and 5%, respectively, of the injected dose over prolonged periods. Radioactivity was transferred to female flies by copulation with treated males. Because this radioactivity was found within the female body and not on its surface, we concluded that transfer was by copulation rather than by body contact. However, no detectable radioactivity was found in the sperm or the seminal fluid present in the spermathecae of inseminated females. An electron microscopic scrutiny of house fly sperm failed to reveal any structural changes brought about by the chemosterilant. (Auth.)

876 Chang, S.C. METABOLISM OF C^{14}-HEXAMETHYLMELAMINE (HEMEL) IN MALE HOUSE FLIES. Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 101, at "New York Meeting of the Entomological Society of America. New York, N.Y., 27-30 Nov. 1967".

Hemel-(methyl-^{14}C) has a specific activity of 6.5 mCi/mM. The sterilizing potency of hemel.HCl by injection to male house flies was determined to be 6.2 µg at 50% effective level. From fly and faeces extract, 6 and 7 radioactive metabolites were resolved respectively. The identification of metabolites will be discussed. (Abstr.)

877 Chang, S.C., Terry, P.H., Woods, C.W., Borkovec, A.B. METABOLISM OF HEMPA UNIFORMLY LABELED WITH C^{14} IN MALE HOUSE FLIES. J. econ. Ent. 60, 6 (1967) 1628-1631.

When hempa was uniformly labelled with ^{14}C and its metabolism in male house flies, Musca domestica L., was studied, total recovery of radioactivity from treated flies and their excreta was about 90%. The recovery of radioactivity from respiratory CO_2 was only 1.25% of the injected 5.71 µg of ^{14}C-hempa/fly during the first 24 h. Radiometric and colorimetric determinations indicated that 2.5-3 h after treatment, treated flies retained 50% of the dose and that at the end of 24 h they retained about 2-3% of the dose. The treated flies were 50% sterile 4 h 45 min after treatment and completely sterile about 7 h after treatment. The only major metabolite of hempa found in treated flies and in their excreta was pentamethylphosphoric triamide. Unchanged hempa and its metabolite were separated from the extracts of treated flies and their excreta by thin-layer chromatography, gas-liquid chromatography, and radiochromatography. For identification, the two compounds were isolated by thin-layer chromatography, and their structure was confirmed by infrared spectroscopy. (Auth.)

878 Collier, C.W., Tardif, R. ANALYSIS OF MALE GYPSY MOTHS FOR MICROGRAM QUANTITIES OF TEPA. J. econ. Ent. 60, 1 (1967) 28-30.

Two methods were used. In initial tests adult males of Porthetria dispar (L.) < 24-h-old were treated with residual films of ^{14}C-labelled tepa for 8 h, at the 8 mg/bottle level. ^{14}C-tepa, with a specific activity of 6.8 mCi/mM, was diluted with unlabelled tepa. A 16-h holding time reduced the ^{14}C-containing alcohol solubles in the moth by roughly a factor of 2, which suggests incorporation of tepa or its metabolites into tissue proteins. A colorimetric method was developed whereby tepa residues could be determined easily to 0.5 µg/moth. The method involves clean-up of moth extracts by means of column chromatography followed by colorimetric analysis. Preliminary cleanup attempts with thin-layer chromatography were unsuccessful. Data obtained indicate that the amount of tepa residues in moths depends on the holding time after treatment. The residues diminish with increasing holding times between treatment and analysis. Washing treated moths with water also has been found helpful in lowering the tepa residue. In general, it can be stated that the lowest practical level obtainable is in the order of 1-5 µg. These levels were obtained by washing immediately after treatment followed by a holding period of 0-16 h. All residue data were determined on moths which had been exposed for a period of 8 h to residual films of 1 mg/dm² of tepa. This treatment is currently considered the most practical for producing sterile moths for field release.

879 Cox, H.C., Young, J.R., Bowman, M.C. PERSISTENCE OF TEPA IN FALL ARMYWORM MOTHS. J.econ.Ent. 60, 4 (1967) 1111-1115.

The persistence of tepa in male and female fall armyworm moths, Spodoptera frugiperda (J.E. Smith), was determined by radiometric and gas chromatographic (GLC) procedures. The radiometric analyses showed considerably more tepa on and in the insects than did the specific GLC analyses, an indication that ^{14}C-labelled fragments of the tepa molecule were being analysed as tepa. Within 24 h > 90% of the tepa disappeared from moths that ingested as much as 100 µg/moth. More than 95% disappeared within 48 h. (Auth.)

880 Fletcher, T.E., Dennis, D.L., Ross, H.B. DISTRIBUTION AND POSSIBLE MECHANISM OF ACTION OF THIO-TEPA IN EXPERIMENTAL BREAST CANCER. Trans.R.Soc.trop.Med.Hyg. 46, 6 (1952) 1437-1440.

The uptake and distribution of ^{32}P-labelled thiotepa was studied in induced hormone-sensitive breast cancer in the Sprague-Dawley rat. The concentration of labelled thiotepa in the ovary and adrenal was over twice that in the tumour and the concentration in the pituitary was 15 times that in the tumour. Pituitary, ovary and adrenal weights of treated animals kept for 5 weeks were less than those of untreated control animals. The possibility that the antitumour effect of thiotepa may be mediated through the neuro-endocrine system rather than by a direct effect on the tumour is discussed. (Auth. summary)

881 Hedin, P.A., Wiygul, G., Mitlin, N. ABSORPTION AND METABOLISM OF C^{14}-LABELED TEPA BY THE BOLL WEEVIL. J.econ.Ent. 60, 1 (1967) 215-218.

Some aspects of the absorption and metabolism of ^{14}C-labelled tepa by the male boll weevil, Anthonomus grandis Boheman, were studied. Topically applied tepa* is absorbed almost immediately into the haemolymph, where it reaches a peak in 1-3 h and then slowly declines. This trend parallels a decline of tepa on the cuticle to 10% within 6 h. Values of the differential distribution ratio for body parts and organs were determined for injection and for topical treatment on the abdomen. Selective concentration occurred in the foregut, testes, and wings with injection and in the wings only with topical treatment. Radioactivity detected in the spermathecae of females mated to treated males gave presumptive evidence that the sperm was labelled. About 85% of the initial radioactivity was detected in faeces, expired CO_2, other expired volatiles, and body of injected insects after 2 d. Of the residual radioactivity in the body at 2 d, more than 85% was bound by constituents with low mol.wt. (Auth.)

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* (0.63 µg/weevil)

882 Hedin, P.A., Wiygul, G., Vickers, D.A., Bartlett, A.C., Mitlin, N. STERILITY INDUCED BY TEPA IN THE BOLL WEEVIL: EFFECTIVE DOSE AND PERMANENCY, GONADAL CHANGES, AND BIOLOGICAL TURNOVER OF LABELLED COMPOUND. J.econ.Ent. 60, 1 (1967) 209-214.

The male boll weevil, Anthonomus grandis Boheman, was sterilised with tepa, either by feeding 1500 ppm in the diet for 2 d or by an injection of 3.5 µg. Lower levels produced transitory sterilisation. At the effective levels, mortality was significant. A recovery of fertility occurred about 5 d after treatment at the 1.5 µg level. This recovery was less marked with an artificial diet than with cotton buds. In a study of single pairs 12 of 27 males, surviving treatment at the 1.0-µg level, regained fertility within 36 d. Decreases in the size of the testes and changes in morphology and cytology occurred. ^{14}C-Tepa (0.63-1.86 µg) in 0.1 M phosphate buffer (pH 7.5) was either applied topically to the prothorax or injected into the abdomen. The tissue was subsequently digested with nitric acid immediately after treatment, and the radioactivity counted individually with a gas-flow counter. Treated groups containing at least five insects were analysed individually at intervals during a 10-d period. The radiosensitivity of such treated insects decreased by half in 6-48 h, depending on the diet but 10-20% was retained for at least 10 d. No differences related to post-treatment diet were observed. Nitric acid was employed for digestion of insect tissue prior to ^{14}C gas-flow counting. Conditions are described for reproducible and near-quantitative counting of the isotope.

883 Hoopingarner, R., Wilson, G.B. CHROMOSOME EFFECTS OF AZIRIDINYL CHEMOSTERILANTS. Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 102, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Chromosomes were examined at sequential times after 30 min treatment. Mitotic effects were characterized. Most effects were delayed at least one cell generation and persisted several cell generations. The delayed effect was examined by fractionating the chromosomal components after treatment with ^{14}C and ^{32}P aziridinyl compounds. (Abstr.)

884 Kilgore, W.W., Painter, R.R. PERSISTENCE OF TEPA INGESTED BY FALL ARMYWORM MOTHS. Bull. ent. Soc. Am. 12 (1966) 288. Abstr. 103, at "Portland-Meeting. Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

A small quantity of ^{14}C has been found in the eggs of house flies chemosterilized with ^{14}C-tepa. Most of the radioactivity is in the acid-soluble fraction of the nucleic acids. It has also been demonstrated that these eggs are low in DNA as has been found for apholate eggs. (Abstr.)

885 Kilgore, W.W., Painter, R.R. INSECT CHEMOSTERILANTS: INCORPORATION OF 5-FLUOROURACIL INTO HOUSE FLY EGGS. J. econ. Ent. 59 (1966) 746-747.

A mixed population of 400 newly emerged adult houseflies was fed a diet containing 0.05% 5-fluorouracil-2-^{14}C (specific activity 5.0 mCi/mM) for 48 h. The total amount actually incorporated into the fly egg RNA, and existing as 5-fluorouridylic acid, was very small Evaluation of the nucleotide content of the purified material showed that the sample contained ~ 0.79 μM uridylic acid and 0.0004 μM 5-flouorouridylic acid-2-^{14}C/mg RNA. In treating either sex and then allowing it to mate with the untreated sex 5-fluorouracil-2-^{14}C was found to be incorporated into sperm while a measurable amount was incorporated into the eggs. The study indicates that the chemosterilant may sterilize M. domestica eggs by replacing the normal metabolite uracil in RNA. This abnormal RNA undoubtedly causes changes in the metabolism of the eggs which is sufficient to render them non-viable. The antimetabolite, or a metabolic product, is transferred to the fertilized eggs through the females, and not the males.

886 Kilgore, W.W. CHEMOSTERILANTS. p.197-239 of "Pest Control. Biological, Physical, and Selected Chemical Methods". Kilgore, W., Doutt, R.L., Eds. New York, Academic Press. 1967, 477p.

Comprehensive review article. In a section dealing with chemicals affecting reproduction, a partial list of which is given in a table, the chemical types of compounds are broken down into three major categories: alkylating agents, antimetabolites, and miscellaneous chemicals. In reviewing work on the metabolism and mechanism of action of antimetabolites and alkylating agents, the use of radioisotopes is indicated for numerous of the studies cited (p.219-225).

887 Painter, R.R., Kilgore, W.W. THE EFFECT OF APHOLATE AND THIOTEPA ON NUCLEIC ACID SYNTHESIS AND NUCLEOTIDE RATIOS IN HOUSEFLY EGGS. J. Insect Physiol. 13, 7 (1967) 1105-1118.

The nucleic acid synthesis in normal viable housefly eggs and non-viable housefly eggs deposited by flies chemosterilized by apholate and thiotepa has been studied. During normal embryonic development, there is a rapid many-fold increase in DNA after an initial lag period. In the chemosterilized eggs there is almost no increase in DNA, but some accumulation of the deoxyribosidic components of the acid-soluble extract. The effect on the levels of RNA and ribosidic components of the acid-soluble extract is less apparent. In an effort to study the metabolism of aziridinyl compounds in houseflies, normal and chemosterilized flies were fed glycine-^{14}C in an attempt to label the adenine and guanine moieties of egg RNA. The nucleotide ratios of normal housefly eggs has been determined to be similar to that reported for other insect eggs. Apholate-sterilised eggs were significantly lower in adenylic acid than normal-fly egg-RNA. The RNA of the thiotepa sterilised eggs was a little lower in guanylic acid and contained an unidentified compound not present in normal egg RNA. When thiotepa ^{32}P was the chemosterilant, all components of the isolated sodium RNA were labelled. This suggests that thiotepa may have been degraded and the resulting inorganic phosphate reincorporated into the RNA. There was no evidence of alkylated guanine in the RNA.

888 Rukavishnikov, B. STERILISATION CHIMIQUE DES INSECTES NUISIBLES. Zashch. Rast. No. 3 (1967) 46-51. (In Russian, with French summary)

889 Terranova, A.C., Schmidt, C.H. METABOLISM OF HEMPA IN THE CABBAGE LOOPER. Bull. ent. Soc. Am. 12 (1966) 288. Abstr. 102, at "Portland Meeting. Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

Several chromatographic analytical techniques were developed. 5th-instar larvae were injected with ^{14}C-hempa; the material was rapidly excreted, over 80% of activity was present in the faeces in 6 h. Analytical and biological results were discussed. (From abstr.)

890 Terranova, A.C., Schmidt, C.H. PURIFICATION AND ANALYSIS OF HEMPA BY CHROMATOGRAPHIC TECHNIQUES. J. econ. Ent. 60, 6 (1967) 1659-1663.

Paper chromatography was of little value in determining the purity of hempa because of co-chromatography. Thin-layer chromatography in 8:2 benzene:ethanol on silica gel G successfully separated hempa from seven contaminating materials. Also, gas chromatography on an 8-ft column of 6% (w/w) DEGS separated the eight components present in a sample of ^{14}C-labelled hempa. The quantitation of the mass and radioactive responses was linear from 0.2 ng to at least 20 ng. (Auth.)

891 Wickramasinghe, D.N.T. OBSERVATIONS ON THE MODE OF ACTION OF 2-IMIDAZOLIDINONE, A FEMALE STERILANT OF THE ADULT HOUSEFLY Musca domestica L. (DIPTERA: MUSCIDAE). Diss. Abstr. 26, 2 (1965) 880.

Oral administration of 2-imidazolidinone for prolonged periods caused sterility in female house flies. Depending on the dose, the flies laid a high percentage of non-viable eggs or failed to oviposit. The dose at which almost complete inhibition of oviposition occurred was 0.8% in the diet for at least 4 d prior to the 1st protein meal. The treated flies deposited yolk at a slower rate; had ovaries containing less DNA, RNA, protein, and lipid; and incorporated less injected radioactive acetate into various biochemical fractions than control flies. In addition, the treatment resulted in a decrease in the level of a specific blood protein and accumulation of secretory granules in the neurosecretory cells of the brain. The increase in neurosecretory material appeared to be correlated with the inability of the treated fly to lay eggs. Whether the antihormonal effect is due to a direct action on the endocrine organs or whether it is a result of a lack of feed-back from the ovaries was not clarified. The data indicate that the drug did not act as an antimitotic agent nor as an alkylating agent. Rather the evidence suggests an anti-metabolic effect of 2-imidazolidinone. (DA)

1.5.10. Synergists

892 Casida, J.E., Engel, J.L., Essac, E.G., Kamienski, F.X., Kuwatsuka, S. METHYLENE-C^{14}-DIOXYPHENYL COMPOUNDS: METABOLISM IN RELATION TO THEIR SYNERGISTIC ACTION. Science, N.Y. 153 (1966) 1130-1133.

The methylene-^{14}C group is hydroxylated yielding formate-^{14}C in the microsome-reduced nicotinamide-adenine dinucleotide phosphate system in vitro and yielding expired $^{14}CO_2$ in living mice and houseflies. Methylenedioxyphenyl compounds apparently serve as alternate substrates for this enzymatic hydroxylation system of microsomes, and thus reduce the rate of metabolism and prolong the action of certain drugs and insecticide chemicals. (Auth.)

893 Essac, E.G., Casida, J.E. METABOLISM AND ACTION OF METHYLENEDIOXYPHENYL SYNERGISTS IN THE HOUSE FLY. Bull. ent. Soc. Am. 12 (1966) 266. Abstr. 62, at "Portland Meeting. Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

Houseflies metabolised each of 7 methylene-^{14}C-dioxyphenyl compounds to yield $^{14}CO_2$. The microsome-$NADPH_2$ system is involved in this metabolism which is apparently initiated by hydroxylation of the methylene group. Studies on synergist metabolism under in vivo and in vitro conditions will be discussed in relation to the mechanism of synergist action. (Abstr.)

894 Fishbein, L., Fawkes, J., Falk, H.L., Thompson, S. THIN-LAYER CHROMATOGRAPHY OF RAT BILE AND URINE FOLLOWING INTRAVENOUS ADMINISTRATION OF TROPITAL-METHYLENE-^{14}C. J. Chromat. 31, 1 (1967) 102-108.

The nature of the metabolites of Tropital-methylene-^{14}C (I) in rat bile and urine, after intravenous injections of I, was studied by thin-layer chromatography. The bile and urine samples (20 µl) were applied to Silica Gel DF-5 plates. Bile samples were developed with 10:10:1 PhMe-HOAc-H_2O and urine samples with 70:10:20 EtOAc-HOAc-MeOH. The developed plates were photographed in colour under u.v.(2537 Å) illumination, then 4-d autoradiograms were made of the plates. Finally, each plate was sprayed with the chromotropic acid reagent of Beroza (CA 58:4986e) heated 5-10 min at 120°C, and photographed by the procedure of Fishbein et al. (CA 66:114861z). The R_f values and the duration and appearance times are tabulated for the 14 metabolites observed in the bile samples and the 4 metabolites in urine samples (CA 68:1968, 2234g)

895 Garren, R., Jr. UPTAKE AND DISTRIBUTION OF LABELED DIMETHYLSULFOXIDE AND ITS INFLUENCE ON NUTRITIVE ELEMENT TRANSPORT IN PLANTS. Ann.N.Y.Acad.Sci. 141, 1 (1967) 127-130.

The penetration and distribution of dimethyl sulphoxide (DMSO) in a 2-yr-old pear tree, Pyrus calleryana, was followed by means of ^{35}S-labelled DMSO [using $(CH_3)_2{}^{35}S$], to provide information on systemic distribution, time involved, and possible phytotoxic symptoms. The ability of DMSO to penetrate through bark tissue and to become systemic in young pear trees was demonstrated. – In another study, the enhancement of ^{32}P-uptake by roots of 1-yr-old strawberry plants, Fragaria ananassa, in both soil and nutrient solutions treated with DMSO was demonstrated.

896 Kuwatsuka, S., Casida, J.E. SYNTHESIS OF METHYLENE-^{14}C-DIOXYPHENYL COMPOUNDS: RADIOACTIVE SAFROLE, DIHYDROSAFROLE, MYRISTICIN, PIPERONYL BUTOXIDE, AND DIASTEREOISOMERS OF SULFOXIDE. J.agric.Fd Chem. 13 (1965) 528-533.

Five radiolabelled methylenedioxyphenyl compounds, all active as insecticide synergists, were prepared. Methylene-^{14}C iodide, prepared by reduction of iodoform-^{14}C was made to react with the appropriate catechol to yield the following methylene-^{14}C-dioxyphenyl compounds with a specific activity of 1.0 mC/mM: safrole, dihydrosafrole, myristicin, sulfoxide synergist {1,2-methylenedioxy-4-[2-(octylsulfinyl)propyl] benzene}, and piperonyl butoxide {α-[2-(2-butoxyethoxy)ethoxy]-4,5-(methylenedioxy)-2-propyltoluene}. Yields from iodoform-^{14}C were 31 to 55% on a 0.5 to 0.8-mM scale except with piperonyl butoxide, where the yield appeared to be related to the specific activity of the methylene-^{14}C iodide used. The octylthio, octylsulfinyl, and octylsulfonyl analogues of sulfoxide synergist, substituted on the 1-, 2-, or 3-position of the propyl group, were prepared in non-radioactive form for comparative purposes. Sulfoxide synergist and the 1-octylsulfinyl analogue were resolved by chromatography into the enantiomorphs of the diastereoisomers about the sulfoxide grouping and the asymmetric carbon of the propyl grouping. The potency as synergists for the insecticidal activity of carbaryl (1-naphthyl methylcarbamate) and pyrethrum with houseflies (Musca domestica) was compared for all the non-radioactive methylenedioxyphenyl compounds prepared. Carbaryl was highly synergized in its toxicity to houseflies by safrole, dihydrosafrole, and piperonyl butoxide, but less effectively by analogues of sulfoxide synergist. The three (octylthio)propyl analogues were more effective than their sulfoxides and sulfones for carbaryl synergism and, in each series, the potency decreased in the order of 1 > 2 > 3 for the position of sulphur attachment to the propyl group. (NSA 20:1966, 41014)

897 Metcalf, R.L. MODE OF ACTION OF INSECTICIDE SYNERGISTS. A.Rev.Ent. 12 (1967) 229-256.

Review article. Individual sections deal with pyrethroids (site of detoxication relation of structure to synergism), carbamates (N-dealkylation of carbamyl group, hydrolysis, relation of structure to synergism, carbamate detoxifying enzymes and synergism, synergism by organocyanates), organophosphates (activation, N-demethylation and hydrolysis of OP compounds, OP hydrolysing enzymes, synergists), and DDT (DDT-detoxifying enzymes, structure and activity of DDT synergists, synergism with other DDT analogues, resistance to DDT-synergist combinations). – Radioisotopes had been used in numerous studies. (The author's bibliography is complete up to April 1966.) Some otherwise unpublished work by M.F. Osman, the author and T.R. Fukuto is cited on "Metabolism of C^{14}-labelled carbamate insecticides to $C^{14}O_2$ in the house fly". With 2-isopropoxyphenyl-N-^{14}C-methylcarbamate (Baygon ®), from 1-2% of the absorbed dosage was converted to CO_2 in 24 h but with 2-isoprop-1,3-^{14}C-oxyphenyl N-methylcarbamate, an average of ~ 30% was converted to $^{14}CO_2$. Pretreatment of the flies with 50 µg of piperonyl butoxide decreased the $^{14}CO_2$ output from the 2-isoprop-1,3-^{14}C-labelled compound to 6-8% of the amount absorbed. These data strongly suggest the major pathway of Baygon® detoxication in Musca domestica to be O-dealkylation of the

isopropoxy side chain to form ultimately 2-hydroxyphenyl N-methylcarbamate, which is doubtless hydrolysed and conjugated. N-dealkylation of the N-methyl group to form 2-isopropoxyphenyl N-hydroxymethylcarbamate, followed by conversion to the unsubstituted carbamate and to formaldehyde, and then to CO_2 would appear to be a less important pathway.

898 Moos, W.S., Kim, S.E. RADIOPROTECTIVE EFFECT OF TOPICALLY APPLIED DIMETHYL SULFOXIDE ON MICE. Experientia 22, 12 (1966) 814-815. (In English)

Dimethyl sulfoxide (DMSO) applied topically to the major part of mice tails prior to lethal amounts of x-rays offered considerable protection, with 4 of 10 DMSO-treated and 2 of 10 water-treated mice surviving 30 d after a 760-Rexposure. Application of DMSO after irradiation did not alter survival significantly. A single treatment with DMSO for 1 or 5 min before irradiation was as effective in providing protection against x-rays as daily immersions. (CA 66:1967, 26452m)

899 ERRATUM: This reference should have followed ref.581. O'Brien, R.D. TARGET ENZYMES AND INSECTICIDAL ACTION. p.35-39 of "Research in Pesticides". Proceedings of the "Conference on Research Needs and Approaches to the Use of Agricultural Chemicals from a Public Health Viewpoint. Davis, Calif., USA, 1-3 Oct.1964". Chichester, C.O., Ed. New York, Academic Press. 1965, 380p.

Two different approaches to the study of target enzymes appear valuable in the design of insecticides. One approach is the examination of the properties and the precise mechanism of inhibition of known target enzymes. The other is to hunt for new targets to attack. The most fully understood target enzyme is cholinesterase, the target for organophosphate and carbamate insecticides. In the light of a great deal of varied experimental evidence which included data from using radioisotopes it would appear that some real differences exist among cholinesterases, and that these differences can cause selective toxicity, which offers hope for the invention of new selective compounds. In the search for new targets one may (i) explore the mechanism of action on known toxicants, (ii) attempt to inhibit known enzymes or systems whose blockade might be suspected to be lethal, and (iii) look for targets whose identity is unknown (e.g. the neuromuscular junction of insects differs radically from vertebrates in being non-cholinergic).

900 Tzanakakh, M.E. SYNERGISM AND INSECTICIDE ACTIVATION. Hēm.Hron. 28 (1963) 86-97. (In Greek)

General article.*

* Original not available.

See also:

625 Effect of various synergists on toxicity and in vivo metabolism of DDT in Triatoma infestans nymphs. (Fine, B.C. et al., 1966)

797 Relation between synergism and metabolism of dimethoate in mammals and insects. (Uchida, T. et al., 1966)

1.5.11. Repellents

901 Lal, H. DEVELOPMENT OF AN ORALLY EFFECTIVE INSECT REPELLENT. AD-633782, Armour Research Foundation, Chicago, Ill. Jul.1962, 4p.

The objective of the research programme is to develop orally administered insect repellents affording better and longer-lasting protection than conventional surface repellents. Current efforts are concerned with securing selected surface repellents, establishing certain physico-chemical properties of these chemicals and the development of a mosquito colony. (Auth.)

902 Lal, H. DEVELOPMENT OF AN ORALLY EFFECTIVE INSECT REPELLENT. Progress Report for 1 Nov.1962 - 31 Jan.1963. AD-617896, IIT Research Inst., Chicago, Ill. Jan.1963, 15p.

The objective of this programme is to develop a mosquito repellent which is effective when given internally, preferably orally, in order to afford better protection than the conventional surface repellents presently available. Development of a bioassay technique for testing candidate agents using mice as bait and radioactive albumin as an indicator and the repellent properties of several chemical compounds were previously reported. The present report describes further progress on this programme. (Auth.)

1.5.12. Miscellaneous (including Host Plant Resistance)

903 Klun, J.A., Brindley, T.A. ROLE OF 6-METHOXYBENZOXAZOLINONE IN INBRED RESISTANCE OF HOST PLANT (MAIZE) TO FIRST-BROOD LARVAE OF EUROPEAN CORN BORER. J.econ.Ent. 59 (1966) 711-718.

11 maize inbreds were used in a quantitative analysis for 6-methoxybenzoxazolinone (6MBOA) by the technique of isotopic dilution. 2-^{14}C-6-Methoxy-2(3)-benzoxazolinone was synthesised, and isolation and purification of 6 MBOA from plant tissues were accomplished by thin layer chromatography. A correlation exists between the amount of 6MBOA produced by 11 inbred strains of maize at the whorl stage of plant development and the field rating of resistance of the inbred strains to 1st-brood larvae of the European corn borer, Ostrinia nubilalis (Hübner). The correlation can be expressed by the general equation:

Log_{10} (concentration of 6MBOA) = K(resistance rating) + B, where K and B are constants. Highly resistant inbred lines yielded about ten times more 6 MBOA than the highly susceptible inbred strains. The yield of 6MBOA or the content of the glucoside precursor of inbred strains of maize may serve as an indicator of the degree of resistance a given inbred strain may express in the field. Bioassay tests of 6MBOA showed the compound to be an inhibitor of the rate of borer pupation when it was incorporated into an artificial diet at a concentration of 0.5 mg/g diet. No significant difference of mortality or average pupal weight was detected. Addition of vitamin supplement to the diet of the borer grossly attenuated the effect of 6MBOA. If 1 g of diet is assumed to be equivalent to 1 g of tissue from fresh corn plants, the concentration of 0.5 mg per g diet is twice the concentration found in any inbred strain analysed for content of 6MBOA. Evidence indicates that 6MBOA is of little consequence in the phenomenon of resistance. However, precursors of 6MBOA may play an active role. (Auth.)

2. IONIZING RADIATIONS

2.1. CELLULAR AND GENETIC EFFECTS

2.1.1. General Articles. Surveys. Books. Progress Reports (Several Topics)

904 ERRATUM: This reference should have followed ref. 694.
Albanus, L., Heilbronn, E., Sundwall, A. ANTIDOTE EFFECT OF SODIUM FLUORIDE IN ORGANOPHOSPHORUS ANTICHOLINESTERASE POISONING. Biochem. Pharmac. 14, 9 (1965) 1375-1381.

The effect of NaF in sarin, Tabun, and ^{37}S-N^+(the thiocholine analogue of sarin) poisoning was studied. In mice NaF alone could not protect against sarin, but had a substantial antidote effect against ^{37}S-N^+. When given prophylactically together with atropine, NaF (20 mg/kg) increased the LD 50 of sarin 4.5-fold, that of ^{37}S-N^+ 7.5-fold, and that of Tabun 2.5-fold. Therapeutic effect in sarin and Tabun poisoning was noticed. Brain and particularly muscle cholinesterase from sarin-poisoned mice was higher after previous administration of NaF, and the cholinesterase activity of the erythrocytes from sarin-poisoned dogs increased upon administration of NaF. In anaesthetized sarin-poisoned cats NaF restored the blocked neuromuscular funtion. The effect on the bradycardia and on the blood pressure was small. (CA)

905 Baccetti, B. ATOMIC ENERGY IN THE CONTROL OF INSECTS. Georgofili 9 (1962) 319-334. (In Italian)

The effect of ionizing radiation on the life span, fertility, and histologic structure of various species of insects is surveyed, and relative radiosensitivities of the species are compared. Success of the sterile male technique with different insect pests is outlined. Problems encountered in raising large numbers of insects for field studies are pointed out and discussed. Requirements that must be met for use of the sterile male technique on a large scale are listed and discussed. The author discusses, in particular, his own studies on Dacus oleae and Thaumetopoea pityocampa (pine tree pest). (NSA 21: 1967, 18178)

906 Chiang, I. J. H. STUDIES ON THE INHERITABLE VARIABILITY OF RADIATION OF INSECTS AND THE BIOLOGICAL CONTROL OF (?) STERILIZED INSECTS. J. Agric. For., Nanking 14 (1965) 255-269. (In Chinese)

907 Dubinin, N. P. "EVOLUTION OF POPULATION AND RADIATION". Atomizdat, Moscow, USSR, 1966, 743p. (In Russian)

The book discusses theoretical and experimental fundamentals of modern general and radiation genetics of population, and includes mutagenic effects on plants, insects and domestic animals.

908 European Atomic Energy Community. Leiden Rijksuniversiteit (Netherlands). MOLECULAR AND RADIATION GENETICS (ANNUAL REPORT 1965). Euratom Inf. 4, 11/12 (1966) 1284.

The report covers investigations of the structural and functional effects of ionizing radiation upon various types of DNA under a variety of conditions, as well as investigations of further promising and far-reaching systems. In parallel, extensive investigations are made of the mechanism of

induction of mutations in Drosophila by ionizing radiation with an emphasis on the elucidation of processes involved in postradiation repair. (From Nucl. Med.)

909 Gorodetskiĭ, A. A., Ed. THE BIOLOGICAL ACTION OF NEUTRON RADIATION. "Biologicheskoe Deistvie Neitronnogo Izlucheniya". Kiev, Ukranian SSR, Naukova Dumka Publishing House. 1965, 133p. TT-65-32317. Springfield, Va. 1965, 135p. Translation.

Some mention of work with Drosophila, though most of the work deals with other systems. The relative biological effectiveness of fast neutrons is compared with x-and γ-radiation in a number of biological systems.

910 Grosch, D. S. "Biological Effects of Radiations. A Blaisdell Book in the Pure and Applied Sciences". New York, Blaisdell Publishing Co. 1965, 306p.

The major principles and problems of radiation biology are presented in an orderly framework from which students can expand subjects of particular interest. After introductory considerations of the radiations and their direct and indirect modes of action, the discussion continues through the cellular to the tissue, organ, and organism level of effect. Industrial applications of radiation for pest control and food processing are discussed briefly. Each of the 16 chapters is followed by a list of references. (From NSA 19: 1965, 42346)

911 Klimpinya, A. DER EINFLUSS DER GAMMA-STRAHLUNG AUF Pegomyia hyoscyami. (The effect of γ-radiation on Pegomyia hyoscyami.) (Entomophaga 12: 1967, 1294) Zashch. Rast. Vredit. Bolez. (1965) 41-43. (In Russian)

912 Lambrev, Z., Dushev, T. EFFECT OF IONIZING RADIATION ON SILKWORM (Bombyx mori). (BAg: 1966, 96711) Nauchny Trud. vissh. selskop. Inst. Vasil Kolarov 14, 2 (1965) 179-182.

913 Montalenti, G. "The Scientific Research Promoted by the Commission for Study of Genetics (now National Center of Genetics) of the National Research Council from its Institution (20 Jul. 1961 - 31 Dec. 1963). Rome, Consiglio Nazionale delle Ricerche". 1964, 224 p.

The genetic studies on plants, insects, microorganisms, monkeys, other mammals, and man carried out at the Universities of Milan, Padua, Bari, Pisa, Firenze, Pavia, Parma, Turin, Cagliari, Naples, Rome, and Modino and by the Instituto Superiore de Sanita and the Centre for the Study of Genetics at Pavia are briefly summarized. The publications made on completed studies are tabulated. (NSA 19: 1965, 21809)

914 Rai, K. S. TECHNIQUES FOR THE STUDY OF GENETICS AND CYTOGENETICS OF VECTORS. In "Genetics of Disease Vectors". Wright, J., Pal, R., Eds. Amsterdam, The Netherlands. Elsevier Publishing Company. In press 1967.

915 Stern, C. RADIATION, MUTATION RATES AND DEVELOPMENTAL GENETICS OF Drosophila. p. 85 of "Research and Development in Progress - Biology and Medicine. Issue No. 4". TID-4204, Division of Biology and Medicine (AEC), Washington, D. C. Apr. 1966, 229p. Abstr. BIA 2467.

x-rays to be used.

916 Zimmer, K. G. SOME UNUSUAL TOPICS IN RADIATION BIOLOGY. Radiat. Res. 28 (1966) 830-843.

Among the topics discussed in the lecture, presented at the 14th Annual Meeting of the Radiation Research Society, Coronado, Calif. were Single Hit Effects in Radiobiology. Experiments with Drosophila on sex-linked lethal mutations indicate a single-hit effect. The influence of the stage of germ cells on x-ray-induced mutations is shown by dose effect curves for various stages of germ cells. Radiation studies on water snails demonstrate that single-hit curves can arise through superposition of multi-hit curves. γ-radiation experiments with RNase in air and in N_2 result in single-hit inactivation curves.

See also:

1287 Effect of ionizing radiation x-rays on the silkworm (Bombyx mori). (Lambrev, Z. et al., 1965)

1260 Biological organization in relation to differential gene response to mutagens. (Fahmy, O. G. et al., 1965)

1290 Effects of γ-radiation on the cotton stainer. (Simon, F. et al., 1963)

2.1.2. Nuclear and Cytoplasmic Biochemistry, Physiology and Ultrastructure

917 Bonnier, G. NOTE ON THE RELATIVE SENSITIVITY TO IRRADIATION DAMAGE IN HOMOZYGOUS AND HETEROZYGOUS Drosophila melanogaster WITH REGARD TO THEIR CAPACITY OF PRODUCING OFFSPRING. Hereditas 40, 2/3 (1959) 676-677.

Doses of 6-10 kR of x-rays were administered to D. melanogaster, Canton-S. Differential radiosensitivity was observed in different stocks. The degree of x-ray sensitivity was largely dependent on the degree of homozygosis. The dose effect is described.

918 Borstel, R.C., von INDUCTION OF NUCLEAR DAMAGE BY IONIZING AND ULTRAVIOLET RADIATION. p. 248-250 of "Progress in Photobiology". Christensen, B.C., Buchmann, B., Eds. Amsterdam, Elsevier. 1961.

To assess radiation effects on the nucleus, the haploid-diploid genetic system of the wasp Habrobracon were studied and the results correlated with data for the fruit fly Drosophila. The value of the haploid cell is in its lack of two genetic complements that would buffer, cover, or alter the radiation effects. Nuclear radiation damage was divided into five classes according to the various syndromes associated with death of the cell or embryo. These are summarized as follows: Type I, death after one or a few nuclear divisions; Type II, death after many nuclear divisions (in Habrobracon characterized by death after blastoderm formation and before hatching in unfertilized eggs, death occurs predominantly after hatching in fertilized eggs); Type III, death after many nuclear divisions (in Habrobracon death occurs after blastoderm formation and before hatching in unfertilized and fertilized eggs); Type IV, death and pycnosis soon after irradiation (characteristic of lymphocytes, young primary gametocytes, late gonial cells, and neuroblasts); and Type V, dominant lethality expressed in eggs after irradiation in the gonial stage (in Habrobracon, embryo dies late in development). In Habrobracon, the Type-I lethal syndrome can be induced by agents that inhibit meiosis or mitosis. Therefore, the depression of the rate of the mitoses following meiosis is a sufficient action of the radiation to bring about the Type-I lethality syndrome. Type II lethality can be attributed to chromosome imbalance of limited extent. Following treatment of oocytes with ionizing radiation, a small consistent fraction of Type-I lethality is repaired when the egg is fertilized with a normal sperm. It seems likely that the Type-I lethality from irradiation of the nucleus can be induced through at least two distinct mechanisms, one capable of being reactivated. (NSA 21: 1967, 16491)

919 Borstel, R.C. von EFFECTS OF RADIATION ON CELLS. p. 60-125 of "The Biological Basis of Radiation Therapy". Schwartz, E., Ed. London, Pitman Medical Publishing Co., Ltd. 1966, 624p.

After dealing with kinetic considerations the author describes manifestations of radiation-induced cellular injury and modifications of response. A series of tables have been compiled. The tables giving a survey of relative sensitivity of the nucleus and cytoplasm to irradiation includes some studies on insects (p. 80-81), also in the table on the types of cell killing and sperm inactivation events induced by radiation or chemical mutagens in mature gametes and during gametogenesis (p. 82-83, consisting essentially of expanded data of III/998), and some references to insects in the survey of studies concerned with chromosome number and x-ray sensitivity (p. 105-106). A total of 242 references are given.

920 Kernaghan, R.P. GENETIC CONTROL OF XANTHINE DEHYDROGENASE IN Drosophila melanogaster. Thesis, Connecticut Univ., Storrs. 1963, 86p.

Xanthine dehydrogenase activity in D. melanogaster is controlled by at least three functional units; rosy (ry), maroon-like (ma-1), and bronzy (bz). Mutation in any one of the units results in a pleiotropic phenotype including the absence of xanthine dehydrogenase activity. 24 x-ray induced rosy mutants selected with a chromosome totally deficient for the rosy genetic unit, fail to complement ry^2. These data support the notion that the $rosy^+$ unit conditions a single function in the control of xanthine dehydrogenase activity. Several rosy mutants which occupy separable mutational sites in the rosy unit, as well as $ma\text{-}1^1$, $ma\text{-}1^2$, and bz were analysed with respect to the presence of an altered enzyme molecule capable of cross reacting with antibody to xanthine dehydrogenase (CRM). Extracts of wild type and mutant genotypes were partially purified with Sephadex. Xanthine dehydrogenase activity was estimated by the increase in optical density at 395 mμ due to the production of reduced thionicotinamide adenine dinucleotide as a measure of the enzymatic conversion of 2-amino-4-hydroxy-pteridine to isoxanthopterin. Mutant extracts were tested for their ability to remove specific anti-enzyme activity from antibody preparations. The anti-enzyme activity remaining following pre-treatment was estimated by the addition of active enzyme and subsequent assay of residual enzyme activity. $Ma\text{-}1^1$ and bz were positive while $ma\text{-}1^2$ was negative with respect to CRM activity. Several rosy mutants (ry^1, ry^2, ry^8, ry^9, and ry^{23}) were substantially negative. An anti-$ma\text{-}1^1$ antibody preparation inactivated the wild type enzyme whereas an anti-ry^2 antibody preparation was ineffective. These data are interpreted on a combining subunit hypothesis with contributions from rosy, maroon-like, and bronzy genetic units producing the xanthine dehydrogenase molecule. (DA)

921 Khashim-Akhmed, M.S. CYTOGENETIC ANALYSIS OF LETHAL MUTATION INDUCED DURING DIFFERENT STAGES OF SPERMATOGENESIS IN Drosophila. Vest. leningr. gos. Univ., Ser. Biol. 20, 4 (1965) 85-93. (In Russian, with English summary)

Premeiotic stages of spermatogenesis of D. melanogaster (D-18), after irradiation by x-ray 2000 R show a higher percentage of mutation when treated males were transferred to high temperature (36.5°C) for 8 h as compared to 25°C. This phenomenon does not occur at a higher dose of 4000 R. The effect of higher temperature on the x-ray induced rate of point mutation in these stages may involve an enhancement of the restitution mechanism which gives rise to interstitial micro-aberrations and lethals. High temperature led to an insignificantly higher rate of induced sex-linked lethals in 9 out of 10 repetitions in postmeiotic stages (sperms and spermatids). The difference in per cent of recessive lethals in sperm and spermatid stages is due mainly to higher induced chromosomal aberrations in the latter. Between post- and premeiotic stages there is a period of complete sterility, the duration of which was more than 2 d for 2000 R and more than 5 d for 4000 R, and complete sterility was absent during spermatogenetic stages of males irradiated with 550 R and 700 R. (From auth. summ.)

922 Kroeger, H. ZELLPHYSIOLOGISCHE MECHANISMEN BEI DER REGULATION VON GENAKTIVITÄTEN IN DEN RIESENCHROMOSOMEN VON Chironomus thummi. (Cell physiological mechanisms in the regulation of gene activities in giant chromosomes of Chironomus thummi.) Chromosoma 15, 1 (1964) 38-70. (In German, with English summary)

The sequence of appearance and disappearance during normal development of 7 puffs in the giant chromosomes of the salivary gland of C. thummi is described. Among these the loci sensitive to a sudden increase in the titer of ecdysone are determined by transplantation of whole glands into prepupae. The cytological effect of ecdysone is copied by $ZnCl_2$ at 2.3×10^{-2}M concentration both in the intact larva and in the explant. Identical effects are produced by chloroform, butanol and high doses of urethane. Salivary gland cells explanted into haemolymph without addition of Zn^{++} or narcotics change their puffing pattern spontaneously; they revert their direction of development and return to a more juvenile stage. This process is investigated in detail and is found to copy the action of juvenile hormone; it is termed rejuvenation. Rejuvenation and ecdysone effect are antagonistic reactions and exclude one another. Aside from explantation rejuvenation is brought about by x-irradiation, oxygen poisoning and mechanical injury. Rejuvenation proceeds in the partial or total absence of cytoplasm in isolated nuclei. A technique is described that allows for a removal of various fractions of the caryotype from salivary gland nuclei. Using this method it is determined that during rejuvenation the genetic loci form puffs independently of one another and regardless of the presence or absence of the larger part of the caryotype. It is argued that a similar independence of other loci must exist in response to ecdysone. In the explant $ZnCl_2$ starts to lose its power to counteract rejuvenation and to copy the effect of ecdysone at concentrations below

2.8×10^{-3}M. The threshold at which the ecdysone effect is replaced by rejuvenation varies independently from one cell to the next. It can be altered by special handling during the process of explantation. Rejuvenation and the ecdysone effect, as produced by Zn^{++}, are all-or-none reactions; once initiated they both proceed fully to their end points. Zn^{++} has the same effect in haemolymph with a low ecdysone titer as in haemolymph with a high ecdysone titer. Rejuvenation produced by oxygen poisoning in intact larvae persists for more than 20 h after transfer to normal conditions. Once established rejuvenation cannot be reversed by ecdysone imitators. It is concluded that a system controlling the activity of genetic loci resides in the nuclear sap. It is argued that ecdysone and juvenile hormone act via this control system. It is argued that patterns of genetic activities are not maintained and correlated by feedback of the single loci with the cytoplasm or by interaction of parts of the genome. Instead the loci seem to respond individually to a situation prevailing in the nuclear sap. The combination of genes active at any given time (and, therefore, the combination of enzymes available to a cell at any given time) is predetermined by the individual sensitivities of the loci towards the control system in the nuclear sap. The genetic loci acquire their individual sensitivities during the process of determination. (Auth.)

923 Lassota, Z. NUCLEIC ACIDS IN NORMAL AND γ-RAYS IRRADIATED EGGS OF Bombyx mori. Acta biochim. pol. 14, 1 (1967) 7-20.

Normal eggs of B. mori contained at diapause about 0.2 mg of DNA and 3 mg of RNA per 1 g. The DNA content increased about 6-fold on embryogenesis and RNA increased by about 70% but before hatching decreased back to diapausal level. The effects of γ-rays given at diapause, were visible at postdiapausal period only; 5 kR resulted in delayed DNA synthesis and reduced by 15% the hatching; 20 kR delayed the synthesis of DNA, damaged the synthesis of RNA and inhibited hatching completely; 200 kR stopped the synthesis of DNA and induced the break-down of RNA. The eggs were less susceptible to 20 kR when irradiated after the peak of RNA synthesis had been attained. The damage of gastrular RNA synthesis is suggested as a probable cause of injured embryogenesis in 20 kR treated eggs. (Auth.)

924 Nakanishi, Y.H., Iwasaki, T., Kato, H. CYTOLOGICAL STUDIES ON THE RADIOSENSITIVITY OF SPERMATOGONIA OF THE SILKWORM. p. 28-29 of "Annual Report 1964". NIRS-4, National Inst. of Radiological Sciences, Chiba (Japan). Dec. 1965, 94p.

Six successive generations or stages of spermatogonia were accurately identified microscopically. Their relative radiosensitivity was determined by scoring the number of gonocysts containing pycnotic spermatogonia I-VI following irradiation with 1000 R of x-rays, at 300 R/min. An autoradiographic study with ^{3}H-thymidine revealed a significant difference in the percentage of labelled gonocysts among different stages of pycnotic spermatogonia. A definite correlation between radiosensitivity and degree of DNA synthesis at the time of irradiation is indicated. Results showed spermatogonia VI to be most susceptible to x-rays in terms of production of pycnotic degeneration and chromosome clumping. Radiosensitivity was found to decrease in spermatogonial stages VI to I, in that order.

925 North, D.T., Holt, G.G. THE CYTOGENETIC BASIS OF RADIORESISTANCE IN LEPIDOPTERA SPECIES, Trichoplusia ni. Genetics 56, 3 Pt.2 (1967) 580. Paper presented at the "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA. 31 Aug. - 2 Sep. 1967".

The cabbage looper T. ni, as most species of Lepidoptera, is highly resistant to radiation. The chromosomes of Lepidopteran species possess diffuse centromeres and this appears to be the contributing factor to the high degree of radioresistance exhibited by the cabbage looper. The role of the diffuse centromeres in relation to radiation-induced dominant lethal mutations, cell death, and sperm formation will be discussed as well as physiological effects of radiation on mature spermatozoa as they relate to the radioresistance. (Abstr.)

926 Rai, K.S. A CYTOGENETIC STUDY OF THE EFFECTS OF x-IRRADIATION IN Aedes aegypti. Caryologia 17 (1963) 595-607.

927 Riemann, J.G. A CYTOLOGICAL STUDY OF RADIATION EFFECTS IN TESTES OF THE SCREW-WORM FLY, Cochliomyia hominivorax (DIPTERA: CALLIPHORIDAE). Ann. ent. Soc. Am. 60, 2 (1967) 308-320.

When pupae were irradiated with γ-rays from ^{60}Co, wide differences were found in the radiosensitivity of different cell types in screw-worm testes. Almost all very young primary spermatocytes were

apparently killed after having received only 100 R. Most secondary spermatogonia were killed with 500 R, and total destruction of the primary spermatogonia in different testes occurred over a range of dose levels from 1500-3000 R. In testes irradiated with 6000 R, necrosis of most young spermatocytes and of all but a few early secondary spermatogonia was evident at 6-7 h. Until the 8th hour most primary spermatogonia did not show evidence of necrosis and some non-degenerate cells of this class were still seen at 12 h but not at 25 h. Death of all cells apparently occurred during interphase or perhaps very early prophase. Even at the highest dose level (6200 R), secondary spermatocytes and those primary spermatocytes that had reached a certain stage of development were not killed. However, they did suffer gross chromosomal damage, and most spermatids formed from them failed to develop into normal-appearing sperm. No morphological changes could be seen in those cells irradiated as spermatids or as immature sperm, and they developed into normal-appearing mature sperm. The stages in the recovery of spermiogenic activity were traced out in flies that had received 1500 R as 2-d-old pupae. (Auth.)

928 Sado, T. CYTOLOGICAL EVALUATION OF DOSE-RATE EFFECTS OF RADIATION ON MUTATION FREQUENCY OF SILKWORM GONIA. I. KINETICS OF PROLIFERATION AND KILLING OF SPERMATOGONIA DURING CHRONIC IRRADIATION. Mutation Res. 3, 6 (1966) 510-21.

The kinetics of proliferation and killing of spermatogonia of young silkworm larvae during chronic irradiation (^{60}Co or ^{137}Cs γ-rays, 0.126 or 0.130 R/min for 5 d; total dose, 900 R) was studied. The following kinetic indices were determined at various intervals after the onset of the exposure: (a) total viable cell (or gonocyst) counts, (b) incidence of pycnosis, (c) mitotic index, and (d) labelling index, or the percentage of cells that take up ^{3}H-thymidine in 1 h after isotope administration. The results indicate: (1) The majority of secondary spermatogonia were killed during chronic irradiation, and only a few of them (12 cysts per testis) survived the exposure when the larvae were irradiated between 5 and 10 d after hatching where the Type II dose rate effect is observed. (2) With regard to the primary spermatogonia, there was a considerable suppression of mitosis as well as a block of cells in G_1 entering the S phase during the early intervals after the onset of the chronic exposure starting on day 5 after hatching. The distribution of cells at various phases of the cell cycle during chronic irradiation was significantly different from that of unirradiated cell populations to which a single acute dose is generally given to compare the dose rate effect on mutation induction. (3) The radiosensitivity of spermatogonia (both primary and secondary) varied, depending upon the developmental stage of the larvae. The earlier the larvae were exposed to chronic irradiation, the less sensitive were the spermatogonia to radiation killing and mitotic inhibition. The significance of these findings to the mechanism of dose rate effect on mutation frequency in silkworm gonia is discussed. (From auth. summary)

929 Tahmisian, T.N., Devine, R.L., Wright, B.J. AN ELECTRON MICROSCOPE STUDY OF THE EFFECT OF x-IRRADIATION ON DIAPAUSE GRASSHOPPER EMBRYOS. p. 219 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, 26 Jun.-2 Jul. 1966, 263p". Abstr. 870.

In former communications, the effect of x-irradiation on diapause grasshopper embryos was discussed. Diapause is a stage of arrested development in which metabolism is basal and cell duplication does not occur. The embryos remain in "suspended animation" until diapause is interrupted by chilling at 0-5°C for 3 months. After chilling, the embryos develop and hatch in 17 d. A dose of 25 kR during diapause abolishes anabolism but catabolism continues at an accelerated rate. Morphological observations with the light microscope indicate both cell shrinkage and nuclear pyknosis. The embryo undergoes "negative" growth and becomes smaller; it does not maintain normal size. Presently, the electron microscope reveals that the ribosomes disappear and the nuclei become myelinated and pyknotic so that individual chromatin masses are not discernible. The mitochondria throughout the period of negative growth studied appear morphologically normal up to 40 d post-irradiation. The mitochondrial membranes and cristae mitochondrialis survive until the embryo becomes very small. At this time, the mitochondria degenerate and form a separate pyknotic sphere. Since yolk present about the embryo remains constant, it appears that the relationship of the process of anabolism to tissue transformation and maintenance is destroyed. Furthermore, it appears either that RNA and DNA are more susceptible to ionizing radiation than the oxidative mechanisms of the mitochondria, or that a feedback mechanism that maintains the integrity of the chromatin during the quiescent period of diapause is interrupted. Slides of electron photomicrographs were shown to illustrate the state of cells irradiated during diapause. (From abstr.)

930 Treherne, J. E. THE COMPARATIVE PHYSIOLOGY OF THE TRANSFER OF SUBSTANCES BETWEEN THE BLOOD AND CENTRAL NERVOUS SYSTEM. p.1 of "Studies in Comparative Biochemistry. Proceedings of a Symposium of the Biochemical Society. Munday, M. A., Ed.". Int. Ser. Monographs pure appl. Zool. Div. 23 (1967) 208p.

931 Zimmering, S., Fowler, G. x-IRRADIATION OF THE Drosophila MALE AND ITS EFFECT ON THE NUMBER OF SPERM TRANSFERRED TO THE FEMALE. Z. Vererblehre 98 (1966) 150-151.

Experiments were carried out to determine the number of sperm transferred by the male Drosophila after irradiation, with 5000, 25 000, and 50 000 R acute doses (1000 R/min) of x-radiation. Reductions were 20 - 25%, 60-65%, and 85 - 90%, respectively. Thus, at a dose (5000 R) used in many radiation experiments, a significant proportion of sperm failed to be transferred. Some aspect of sperm behaviour, possibly motility, may have been affected by x-radiation. An unexplained result from these experiments was that the proportion of sperm in the spermatheca was greater at higher doses of x-radiation. Preliminary experiments suggested that this was related to the small size of the ejaculate, and not to the effect of the x-rays. Sperm in ejaculates of relatively small size (< 50) from unirradiated males were observed to distribute themselves such that 20-50% or more were observed in the spermathecae. Should the mean percent of sperm in the spermathecae turn out to be of the order of 50% or so from ejaculates of 50 sperm or fewer, it could account for the apparent 1 : 1 sperm : progeny ratio previously reported from ejaculates of this size. In earlier experiments, only sperm in the ventral receptacle was scored. (NSA 21: 1967, 26650)

See also:

169 Biochemical mechanisms of hormone action. (Karlson, P., 1961)
934 Evidence of a diffuse centromere in the European corn borer, Ostrinia nubilalis (Lepidoptera: Pyralidae). (Barry, B. D. et al., 1967)
944 Cytogenetic analysis of lethal mutations induced at various stages of spermatogenesis. (Hashim-Ahmed, M. S., 1965)
973 The effect of x-radiation on the spermatogenesis in certain grasshoppers. (Suomalainen, H. O. T. et al., 1966)
976 Comparative study of the radiosensitivity at different stages of oogenesis. (Trikhomirova, M. M., 1967)
978 Radio-induced mitotic delay in spermatogenesis of Drosophila melanogaster. (Traut, H., 1966)
996 Electron microscope studies of early morphological effects of x-rays on the internal structure of the chromosome. (Carlson, J. G., 1963)
997 Studies of early effects of radiation on chromosomes and mitosis. Progress Report, March 1, 1966-February 28, 1967. (Carlson, J. G., 1967)
1016 Early chromosomal response to x-rays. (Leach, W. M. et al., 1966)
1017 Lack of x-ray induced chromosome "stickiness" in grasshopper neuroblasts. (Leach, W. M., 1967)
1025 Evidence for the two-hit nature of x-ray induced crossing-over in the centromeric region of Drosophila males. (Olivieri, G. et al., 1964)
1042 x-ray induction of 2; 2;3 translocations in mature and immature oocytes of Drosophila melanogaster. (Traut, H., 1967)
1046 Linkage group-karyotype correlation in the house fly determined by cytological analysis of x-ray induced translocations. (Wagoner, D. E., 1967)
1086 On the relationship between the frequency of two types of mutation and soft x-ray doses in Drosophila. (Matsudaira, Y. et al., 1967)
1142 Radiation-induced male sterility exhibited in the P_1 and F_1 generation in Lepidoptera. (North, D. T., 1967)
1224 The effects of nitrogen and oxygen treatments on the frequencies of x-ray-induced dominant lethals and on the physiology of the sperm in Drosophila melanogaster. (Sankaranarayanan, K., 1967)
1249 Retention of the blood-meal in Aedes aegypti following sterilization by chemicals and irradiation. (Akov, S., 1966)
1273 Cytological analysis of formaldehyde induced chromosomal changes in Drosophila melanogaster. (Slizynska, H., 1957)
1283 Institut national de génétique du Japon. (Tokin, B. P., 1967)

1325 A cytological study of the effects of radiation on the development of the reproductive organs of two species of fruit flies, Dacus oleae and Ceratitis capitata; part of a co-ordinated programme of insect control using radiation. (IAEA, Vienna, Austria, 1967)

1384 Cytological study of embryo development in Drosophila melanogaster, following x-irradiation at early developmental stages. (Schneider-Minder, A., 1966)

1419 Estimation of sensitivity of Drosophila melanogaster to radiation using a third-order rotable design. Three Year Comprehensive Report. (Ratty, F.J., 1966)

1585 Studies on the eradication of Anopheles pharoensis Theobald by the sterile-male technique using cobalt-60. VI. Sperm activity in males irradiated with the sterilizing dose. (Abdel-Malek, A.A. et al., 1967)

2.1.3. Meiotic and Mitotic Sensitivity

932 Abrahamson, S., Meyer, H.U., Himoe, E., Daniel, G. FURTHER EVIDENCE DEMONSTRATING GERMINAL SELECTION IN EARLY PREMEIOTIC GERM CELLS OF Drosophila MALES. Genetics 54 (1966) 687-696.

Drosophila males were irradiated with ^{137}Cs γ-rays, and germ cells which were early spermatogonia at the time of irradiation were scored for X-chromosome and II-chromosome lethals. Only the primary, or pre-definitive gonial cells were tested and the experimental procedures avoided the inclusion of clusters of identical mutations in the data. The ratio of induced X to autosome lethals recovered was 1 : 5.5 providing further evidence that germinal selection has occurred in these cells. (Auth. summary)

933 Akhalaya, Y.G. STUDIES OF THE GENETIC NATURE OF RADIATION EFFECTS IN THE SILKWORM. Soobshch. Akad. Nauk, gruz. SSR. 58 (1967) 453-454. (In Russian)

Changes observed in the mutation rates in the silkworm exposed to ionizing x-irradiation during various stages of gametogenesis were analysed. The analysis of the two generations produced by x-irradiated parents confirmed the genetic nature of radiation effects in the silkworm. (NSA 22: 1968, 17014)

934 Barry, B.D., Guthrie, W.D., Dollinger, E.J. EVIDENCE OF A DIFFUSE CENTROMERE IN THE EUROPEAN CORN BORER, Ostrinia nubilalis (LEPIDOPTERA: PYRALIDAE). Ann. ent. Soc. Am. 60, 2 (1967) 487-488.

Larvae were irradiated with x-rays during the late 3rd or early 4th instar. The total x-ray dosage ranged from 1000 to 4000 R. Analysis of spermatocytes at diakinesis revealed that 46% of the 241 cells examined from irradiated material contained 1 or more fragments. Occasional fragments could be observed in the metaphase I plate in cells from irradiated material. No fragments were found in the cytoplasm away from the plate in the 374 cells examined from irradiated material. All the fragments appear to have migrated to the plate, and one may assume that, since the fragments showed centromere activity, the chromosomes must have diffuse centromeres.

935 Borstel, R.C. von, Smith, R.H., Whiting, A.R. GENETIC EFFECTS OF CHRONIC GAMMA RADIATION ON Habrobracon SPERM. Paper presented at the "Radiation Research Society. San Juan, Puerto Rico. 7 - 11 May 1967".

936 Carlson, J.G. A DETAILED ANALYSIS OF MITOTIC DELAY AND REVERSION INDUCED IN THE PROPHASE OF THE GRASSHOPPER NEUROBLAST BY SMALL DOSES OF x-RAYS. Radiat. Res. 27 (1966) 495-496. Abstr. Bc-3, at "14th Annual Meeting of the Radiation Research Society, Coronado, Calif., USA, 13-16 Feb. 1966."

The mitotic progress of selected prophase cells in hanging-drop preparations of grasshopper neuroblasts was determined individually before and at short time intervals after x-raying. Observations were continued for several hours after treatment, or until the nuclear membrane disappeared. Doses of 8, 16, 32, 64, and 128 R were given. In order to make possible a detailed analysis of this delay, prophase was subdivided into seven microscopically distinguishable stages: early, initial middle, intermediate middle, terminal middle, initial late, intermediate late, and terminal late prophase.

The mitotic progress of intermediate late and terminal late prophases is not altered by any of the doses used. Other stages are delayed by each of the doses given, with or without reversion of the cells to an earlier stage. After 128, 64, and 32 R initial, intermediate, and terminal middle prophases revert to earlier stages, the amount of reversion and the total duration of the delay being positively correlated with the dose; after 16 R they show delay but only an occasional intermediate middle prophase cell reverts; after 8 R they are delayed, but with no reversion. Early prophases are delayed but not reverted by any of the doses used. The critical stage is initial late prophase, which may show no delay even after 128 R or reversion with as little as 32 R, or delay with 8 or 16 R. An interesting feature of delay and reversion is the inertia of the mitotically progressing cell, which after treatment nearly always progresses at a normal rate to the next stage before slowing down or reverting 1-4 stages, depending on the dose and stage irradiated. All cells eventually recover and complete division. (Abstr.)

937 Dickerman, R.L. MUTAGENIC EFFECT OF NEUTRONS AND x-RAYS ON Drosophila melanogaster OOCYTES AND OOGONIA. p. 167-169 of "Biological and Medical Research Division Annual Report, 1966". ANL-7278, Argonne National Lab., Ill. Dec. 1966, 335p.

The effects of 250 kVp x-rays and of 0.2-0.3 MeV neutrons were investigated on stage 7 (the most mature stage in newly emerged adult females) and oogonia. For irradiation, the flies are placed in small lucite cells and constrained into a layer 1 fly thick. Survival curves (egg to adult) plotted for the radiations gave an RBE of neutrons to x-rays of ~4.9. - Any irradiated oogonial cell able to complete the 4 synchronous mitotic divisions to form 15 nurse cells and 1 oocyte has an equal probability of surviving, largely independent of dose. - Intended work is discussed.

938 Fox, D.P. THE EFFECTS OF x-RAYS ON THE CHROMOSOMES OF LOCUST EMBRYOS. I. THE EARLY RESPONSES. Chromosoma 19 (1966) 300-316.

5-d-old eggs of Schistocerca gregaria were incubated at 27°C and exposed to 100 R/min, the exposure rate being maintained constant and the exposure time varied. Irradiation of embryo cells of S. gregaria in the 2 h before mitotic anaphase produces a characteristic series of responses. An apparently insensitive stage is followed by the production of "stickiness" and side-arm bridges and finally by mitotic delay. Mitotic delay is complete at doses as low as 25 R. It is argued that "stickiness" is due to a generalised physiological process and that side-arm bridges are due to a localised exchange of discrete sub-units of the chromatid. These conclusions are based upon the kinetics of appearance and dose-response and a comparison of haploid and diploid cells in a haplo-diploid mosaic embryo.

939 Fraccaro, M., Tiepolo, L. BIOLOGICAL EFFECTS OF IONIZING RADIATION. Path. Biol., Paris Sem. Hôp. Paris 11 (1963) 1171-1178. (In Italian)

The mode of action of ionizing radiations, their effects on functions and cellular structures and effects on the synthesis of DNA, of RNA, and of proteins are discussed. It is pointed out that radio-induced mutations can be due to effects on chromosomes or genes. These two categories are examined separately. Particular attention is paid to the problem of the differences of sensitivity of the gametic cells in the various stages of their development in the light of experimental work on Drosophila and mice. The problem of chromosomal anomalies induced by radiation in cells of mammals in tissue culture is examined. The question of the genetic effects of radiation in man is discussed, with emphasis on methodological difficulties. (Auth.)

940 Fritz-Niggli, H. RADIOMUTABILITY AND HETEROGENEITY OF MALE GERM CELLS OF Drosophila BEFORE, DURING, AND AFTER MEIOSIS. Biophysik 3 (1966) 97-117. (In German)

A cytological study of the testes of D. melanogaster in the larval and prepupal stages was made, following electron and γ-irradiation. Irradiation of larval and prepupal stages resulted in heterogeneity of developing germ cells. Heterogeneity was evident in radiosensitivity and in mutability of germ cells. The effect of radiation on the frequency of dominant lethal factors was studied. Mortality of embryos was highest after irradiation of spermatocytes in 78- to 91-h larvae. Recessive sex-linked lethal factors were observed frequently in meiotic and post-meiotic stages of germ cells. Translocations occurred rarely in spermatocytes and spermatogonia. Chromosome losses occurred in meiotic and post-meiotic stages more often than in spermatocytes. (NSA 21: 1967, 18021)

941 Grosch, D. S. BIOLOGICAL EFFECTS OF RADIATION. Bios 36 (1965) 55-62.

The effects of ionizing radiations at the cellular level are discussed, with particular reference to studies using Habrobracon. Advantages of using Habrobracon in cytological studies are presented. Cells differing in radiation vulnerability are present in the ovariole of Habrobracon. Egg production data following a series of x-ray doses are shown. In the developing state the ovariole contents present differentiated, transitional, and primitive cells. Eggs deposited at any time subsequent to exposure may be traced back to the cytological condition of the oocyte or stem cell at the time of treatment. Eggs ready for deposit or large oocytes about to become eggs are unresponsive, short of massive radiation doses, if oviposition is the criterion. Hatchability is another matter entirely. Just because an egg is laid does not mean that it will hatch. It will not if genetic damage seriously interferes with embryonic development. Problems in the use of ionizing radiations to destroy insect pests are also considered. (NSA 20: 1966, 8650)

942 Hannah-Alava, A. THE PREMEIOTIC STAGES OF SPERMATOGENESIS. TID-21562, Turku Univ. (Finland). 1964, 91p.

A review is presented on germ-cell maturation primarily in D. melanogaster. The subjects discussed include: maintenance of the germ-line and spermatogonial multiplication; relating temporal and spatial patterns of spermatogenesis; and radiosensitivity of spermatogonia. 175 references are cited. (NSA 20: 1966, 14224)

943 Hannah-Alava, A. MUTATION RATES AT SPECIFIC AUTOSOMAL LOCI IN DIFFERENT SPECIES OF Drosophila. p. 59-61 of "IAEA Research Contracts. Sixth Annual Report". Technical Reports Series No. 53. Vienna, International Atomic Energy Agency. 1966, 131p.

The period of contract was from 1 Nov. 1959 - 31 Oct. 1964. The primary purpose of the work was the accumulation of data on mutation frequencies, in Drosophila melanogaster, of specific IIIrd-chromosome loci from cells that were in different stages of maturation at the time of treatment with x-rays, with particular emphasis on spermatogonial mutation rates. Data on frequencies for IIIrd-chromosome recessive lethals, and on dominant (visible) mutations and Minute mutations in all chromosomes have also been obtained. Methods and results are summarized, and a list is given of 8 papers published during tenure.

944 Hashim-Ahmed, M. S. CYTOGENETIC ANALYSIS OF LETHAL MUTATIONS INDUCED AT VARIOUS STAGES OF SPERMATOGENESIS. Genetika No. 3 (1965) 49-55. (In Russian)

Premeiotic stages of spermatogenesis in x-irradiated (2000 R) Drosophila melanogaster showed a higher percentage of mutation when treated males were transferred to high temperature (36.5°C) for 8 h as compared to 25°C. This phenomenon does not hold equally for a higher dose of 4000 R. Results indicate that the effect of high temperature on x-ray induced rate of point mutation in these stages may involve an enhancement of the mechanism of restitution which gives rise to interstitial microaberrations and lethals. High temperature led to an insignificantly higher rate of sex-linked lethals in nine repetitions out of ten in postmeiotic stages (sperms and spermatids). Between post- and premeiotic stages there is a period of complete sterility, the duration of which exceeded 2 d for 2000 R, ran beyond 5 d for 4000 R and was not observed during spermatogenetic stages of males irradiated with 550 and 700 R. (Auth.)

945 Kale, P. G. SPERMATOGONIAL CROSSING OVER IN Drosophila melanogaster AND Drosophila ananassae. Genetics 55, 2 (1967) 255-262.

Wild females inseminated by recessive males were allowed to lay in petri dishes for an hour, which were then irradiated for 24 or 36 h with 1000 R, 1500 R or 2000 R. Heterozygous males from the resultant pupae were used in the subsequent experiments, details of which are given. The crossover induced by irradiating early developmental stages, of Drosophila is described. Great individual variation was observed in crossover values. The complementary crossovers are very unequal in some of the positive males. Continued appearance of crossovers in the progeny of the positive males throughout the tested period is attributed to the multiplication of primary spermatogonia behaving in an analogous fashion to that of the cambial cells of higher plants.

946 Karimov, A. D., Malinovsky, O. V. ON THE ROLE OF GAMMA TREATMENT OF OOCYTES IN THE REALIZATION OF RADIATION INJURY. Genetika No. 6 (1966) 140-143. (In Russian)

Hatching of eggs obtained from irradiated and non-irradiated females crossed with irradiated and non-irradiated males was studied. It was found that the radiation effect in the case when both oocytes and sperm cells were irradiated simultaneously equals the sum effect of separate irradiation of the female and male sex cells. It follows that oocytes' irradiation does not influence the yield of radiation injured sperm cells. (Auth.)

947 Karimov, A.L., Malinovsky, O.V. ON THE ROLE OF GAMMA TREATMENT OF OOCYTES IN THE REALIZATION OF RADIATION INJURY OF Drosophila SPERM CELLS. Genetika No. 6 (1966) 140-143. (In Russian)

Hatching of eggs obtained from irradiated and non-irradiated females crossed with irradiated and non-irradiated males was studied. It was found that the radiation effect in the case when both oocytes and sperm cells were irradiated simultaneously equals the sum effect of separate irradiation of the female and male sex cells. It follows that oocytes' irradiation does not influence the yield of radiation injured sperm cells. (Auth.)

948 Klimmya, A.Y. EFFECT OF GAMMA RAYS ON DEVELOPMENT OF THE SEX CELLS IN THE BEET FLY. "Sbornik. Ioniziruyushchie Izlucheniya v Biologiie. Riga, Isd-v-Zinatie. 1965".

949 Lamb, M.J., McSheehy, T.W., Purdom, C.E. THE RELATIVE MUTAGENIC EFFECTIVENESS OF FAST NEUTRONS AND x-RAYS IN PRE- AND POST-MEIOTIC GERM CELLS OF Drosophila melanogaster. Mutation Res. 4 (1967) 461-468.

Adult male D. melanogaster were irradiated with doses of up to 1000 rad of x-rays or neutrons (+ 10% γ-rays) and germ cells irradiated at pre-meiotic and post-meiotic stages were tested for the presence of IInd chromosome recessive lethals by the Cy/Bl L method. Lethal mutations found in sperm irradiated at the premeiotic stages were tested for allelism. A satisfactory fit to a linear dose response was obtained for x-rays and neutrons in each germ cell stage. In post-meiotic germ cells, the mutation frequency was 4.35×10^{-5}/rad for x-rays and 9.77×10^{-5}/rad for neutrons with an RBE of 2.24. For pre-meiotic germ cells the mutation frequency for x-rays was 1.36×10^{-5}/rad and 2.80×10^{-5}/rad for neutrons with an RBE of 2.05. There was no evidence that the RBE differed for the two types of germ cells. (Auth.)

950 Leiden Rijksuniversiteit (Netherlands). MOLECULAR AND RADIATION GENETICS. Annual Report 1965. p. 17-21 in "I - Mutation Studies with Drosophila". EUR-2983. e. Sep. 1966, 24p.

Mutation studies on Drosophila, under F.H. Sobels, are described. They are divided into
(1) the analysis of post-radiation recovery phenomena in mature sperm;
(2) differential radiosensitivity of spermatids, mature and almost mature sperm;
(3) post-radiation recovery by O_2 in early spermatids and spermatocytes, sampled from Drosophila pupae;
(4) the effect of storage of sperm after irradiation in N_2 or O_2 on the realization of chromosome aberrations and lethal mutations;
(5) modification of x-ray induced mutation frequencies in different stages of Drosophila spermatogenesis by pre-treatment with actinomycin-D;
(6) nucleic acid synthesis during spermatogenesis in Drosophila;
(7) the mutagenic effect of ^{3}H-uridine.

951 Lüning, K.G. CAN Drosophila SPERMATOZOA BE USED IN STUDIES OF RECOVERY PROCESSES? J. cell. comp. Physiol. 58 (1961) 197-201.

3-4 d old M5; sc Y males were irradiated in air or in N atmosphere. Within 2 min after treatment the males were mated for 24 h to y w sn females and were then transferred to a new group of virgin females for another 24 h mating. After mating the females were allowed to oviposit for two 3-d periods. In the 2nd-day sperm the change in atmosphere had a much slighter effect than in 1st-day sperm. - Heterogeneity was found in sperm available the 1st day after irradiation. - If a recovery process is involved at a dose level below 1100 R one would expect a sigmoid curve on plotting dose against frequency of XO males. Males (3-4 d old) were irradiated and mated for 4 h (0-4th) and again for 4 h (15th-18th hour after irradiation), the doses ranging from 550 to 4400 R. Already at 550 R there was a significant difference between the two mating periods. The experiment fails to show a recovery process in sperm irradiated at a stage supposed to be well supplied with O_2.

952 Makino, S. EFFECTS OF RADIATION ON CELL DIVISION AND CHROMOSOMES IN ANIMALS. Quarterly Report, March 15, 1961 - June 14, 1961. AD-438540, Hokkaido Univ., Sapporo (Japan). 15p.

Progress is reported in studies on the effects of radiations on cell division and chromosomes in animals. Results are reported, amongst others, from studies on the effects of β-particles on cell division in grasshopper spermatocytes, the effects of x-radiation on human cells in culture with emphasis on chromosome breaks, the effects of x-radiation on spermatogenesis of Drosophila virilis. A list is included of publications resulting from these studies.

953* Mandl, A.M. THE RADIOSENSITIVITY OF GERM CELLS. Rev. Camb. phil. Soc. Biol. 39, 3 (1964) 288-370.

The radiosensitivity of germ cells depends on (a) the criterion by which it is assessed, and (b) the developmental stage at the time of irradiation. For any given parameter and cell-type, the final effect exerted by ionizing radiations depends on the genetic make-up and age of the organism; type of irradiation; method of irradiation (acute, fractionated, chronic at different dose rates); oxygen tension; and temperature. The claim that a reduction in dose rate lowers the yield of mutations following gonial irradiation in the male mouse has so far not been confirmed by studies on Drosophila. Primary meiocytes are relatively insensitive to cell-killing. Cells irradiated as spermatocytes may fail, or be slow to complete normal maturation division(s), or they may give rise to morphologically abnormal spermatids. The effect depends upon the phase of meiosis at irradiation. In both sexes, sensitivity to cell-death appears to decrease more or less progressively as meiotic prophase advances; in most female mammals, the trend is sharply reversed at early diplotene, when the oocytes become enveloped within primordial follicles. As the oocyte enters upon its rapid phase of growth which, in many species, is associated with vitellogenesis, sensitivity decreases again. Growing oocytes at the diplotene stage are relatively resistant to cell-killing in almost all species investigated. Due to the brief duration of subsequent stages of meiosis (diakinesis, metaphase I), sensitivity to cell-death is difficult to establish. As judged by the induction of dominant lethals, sensitivity of oocytes increases sharply between diplotene and metaphase I; in rodents, the rise becomes manifest a few hours before the onset of diakinesis. Increases of the same magnitude in the incidence of chromosomal aberrations at anaphase I and II have been scored for microsporocytes. Corresponding data for spermatocytes are less reliable, but there is some evidence indicating the same trend. In general, sensitivity to the induction of mutations is greater in meiocytes than in gonia. The yields of some mutations in the female have been shown to rise as meiotic prophase proceeds; but the relative increase as metaphase I approaches is not always as striking as that recorded for dominant lethals. Differential sensitivity to mutagenesis in spermatocytes at various stages of meiotic prophase has not been fully documented. There is some reason to believe that spermatocytes at early stages of meiotic prophase are less susceptible to mutation induction than those nearing the end of prophase. The sensitivity of secondary meiocytes has not been quantitatively assessed except by the incidence of chromosomal aberrations and dominant lethality. In both plants and animals, cells at metaphase II appear to be somewhat less sensitive than those at metaphase I. Spermatids, whose homologous stage is absent in the female, are apparently highly resistant to the induction of morphological abnormalities or cell-death. In contrast, they are highly sensitive to the induction of dominant lethals and a variety of mutations; those at early stages of spermiogenesis appear to be more susceptible than those approaching full differentiation. Corresponding changes are less readily induced in fully differentiated spermatozoa. Anoxia during irradiation diminishes the difference between spermatids and spermatozoa, without however abolishing it. Spermatozoa irradiated after insemination are more sensitive to mutagenesis than are those retained within the testes or the male genital ducts. Irradiation of differentiated gametes of either sex shortly before fertilization induces a delay in subsequent cleavage. While eggs undergo some spontaneous recovery if the period between irradiation and fertilization is prolonged, spermatozoa do not. There is at present no single working hypothesis to account for all the stage differences recorded. (Auth.)

* See III/539, originally cited without abstract.

954 Michigan State Univ., East Lansing. BASIC FERTILIZATION PHENOMENA AND GAMETIC LETHALITY IN Drosophila. Technical Progress Report, 1966. COO-1033-16, 1966, 11p.

In the course of studying abnormal progeny rates, the effect of supernumerary Y chromosomes has been investigated. The shift in sex ratio related to paternal age has been investigated in X2Y and X3Y males with marked Y-chromosomes. A temperature shock during meiosis can influence the frequency of recovery of X- and Y-bearing sperm; the frequency can, however, also be altered by temperature shock given to mature sperm. - The frequency with which SD-bearing gametes are recovered can be lowered by x-irradiation during meiosis (e.g. 450 R given to 3rd-instar larvae; no noticeable effect on irradiating adult males). Insemination studies (sperm competition for storage) were carried out, using a specially developed autoradiographic technique. Oregon-R females were allowed to lay eggs on a modified Offerman's (non-nutritive) medium on which yeast moistened with an aqueous solution of ^{3}H-thymidine was placed. Adult males grown on these cultures were mated to non-labelled virgin females, and the ventral receptacle of the female dissected after insemination. Individual sperm can thus be labelled.

955 Morey, M. ANALISIS DE LA SENSIBILIDAD GENETICA A LOS RAYOS x EN HEMBRAS DE Drosophila melanogaster. (An analysis of genetic sensitivity to x-rays of ovaries of Drosophila melanogaster.) Genet. iber. 17, 1/2 (1965) 1-68. (In Spanish)

This is essentially a study of oogenesis in D. melanogaster, comparing the normal process with individuals x-rayed at the following dosages: 600 R, 1800 R and 4390 R. The claim is made that an unknown part of the spectrum was discovered and divided into four zones of sensitivity. A new theory for germinal selection in oogonia for dominant lethals is proposed. Oocytes given 4390 R may die but the germinal follicle continues development. They may be reabsorbed or develop into mature eggs but they are sterile. (BA)

956 Murakami, A. RELATION BETWEEN SENSITIVITY TO KILLING AND MUTATION OBSERVED DURING A MITOTIC CYCLE OF SILKWORM CLEAVAGE NUCLEI. Rep. natn. Inst. Genet., Misima No. 17 (1966) 102-103.

957 National Inst. of Genetics, Mishima (Japan). ANNUAL REPORT OF THE NATIONAL INSTITUTE OF GENETICS, NO. 16, 1965. NP-16482. 1966, 148p.

Progress is reported in studies on genetics, cytology, and biochemistry of Drosophila, and other animals, and of certain plants (crop). Radiation genetics studies include the following investigations of silkworm: mechanisms underlying the enhancing effect of induced-mutation frequency after fractionated γ-irradiation of silkworm gonia; time of reversal of radiation dose-rate effect on mutation induction in silkworm gonia; post-irradiation treatment of silkworm spermatogonia with various metabolic inhibitors; proliferation kinetics of silkworm spermatogonia during chronic γ-irradiations; change in distribution of primary spermatogonia of the silkworm at various phases of the cell cycle after irradiation; radiosensitivity of silkworm spermatogonia during the cell cycle; variation in radiosensitivity during the early developmental stage of the silkworm egg; enhancing effect of fractionated irradiation with 14-MeV neutrons on the induction of visible recessive mutations in silkworm gonia.

958 National Inst. of Radiological Sciences, Chiba (Japan). BIOLOGICAL STUDIES: CYTOLOGY AND MORPHOLOGY. p. 28-34 of "Annual Report, 1964". NIRS-4. Dec. 1965, 103p.

Amongst others, some results are also summarized of cytological studies on the radiosensitivity of silkworm spermatogonia to x-rays.

959 Norsk Hydro's Inst. for Cancer Research, Oslo. FIFTH REPORT FROM NORSK HYDRO'S INSTITUTE FOR CANCER RESEARCH FOR 1963-1964. NP-16585. 1965, 68p.

The effects of injected ^{91}Y on reproduction in Drosophila and the x-ray sensitivity of Drosophila spermatogonia are described in one part of the report.

960 Parker, D.R. INDUCED HETEROLOGOUS EXCHANGE AT MEIOSIS IN Drosophila. I. EXCHANGES BETWEEN Y AND FOURTH CHROMOSOMES. Mutation Res. 4 (1967) 333-337.

Break points have been mapped for a group of 51 Y chromosome fragments induced in irradiated D. melanogaster females. The fragments used were derived from a doubly-marked Y-chromosome, $B^{S}Y_{y+}$, which was irradiated in attached-X females in which the oldest oocytes were in stage 7. Fragments arising by exchange with the right arm of chromosome 4 (4R) have the breakages clustered in the long arm of the Y (Y^{L}) proximal to the most distal male-fertility locus, and proximal to the

cubitus interruptus locus in 4 R. Fragments arising by other exchanges have the breakages clustered toward the ends of the Y, usually distal to the most distal male-fertility loci of either arm of the Y. It is suggested that specific, relatively short regions are regularly associated to form "sites" within which the induction of exchange is possible.

961 Parker, D.R. A SURVEY OF METHODS FOR THE INDUCTION OF ABERRATIONS IN MEIOTIC STAGES IN Drosophila FEMALES AND FOR OBSERVATION OF THEIR DISJUNCTIONAL PROPERTIES IN THE ENSUING MEIOTIC DIVISIONS. ORNL-P-3077, Oak Ridge National Lab., Tenn. 1967, 21p.

For abstract, see 962.

962 Parker, D.R. A SURVEY OF METHODS FOR THE INDUCTION OF ABERRATIONS IN MEIOTIC STAGES IN Drosophila FEMALES AND FOR OBSERVATION OF THEIR DISJUNCTIONAL PROPERTIES IN THE ENSUING MEIOTIC DIVISIONS. p. 209-218 of "Effects of Radiation on Meiotic Systems. Report of a Study Group. Vienna, Austria 8-11 May 1967". Vienna, International Atomic Energy Agency. 1968, 223p.

The variety of chromosomes available in Drosophila permits the synthesis of special purpose stocks for use in studies on (x-) radiation-induced chromosome breakage and rejoining, the behaviour of newly-induced aberrations in the ensuing meiotic divisions, and factors that affect radiosensitivity. Obtaining identifiable meiotic stages is possible in the case of the female Drosophila, since the meiotic divisions do not occur until after the oocyte is laid, and meiotic prophase extends over a period of approximately a week, making it possible to obtain fairly uniform samples of a single stage by limiting the period of egg collection so that not more than one oocyte is recovered from each ovariole. In the male, meiosis occurs long before the completion of sperm development and the insemination of the female and at best one can distinguish meiotic stages from pre- or post-meiotic ones. Methods are described for the induction of aberrations in meiotic stages in Drosophila females and for observation of their disjunctional properties in the ensuing meiotic divisions. (From NSA 21: 1967, 30869)

963 Rai, K.S. TECHNIQUES FOR STUDYING THE EFFECTS OF RADIATION ON MEIOSIS AND RELATED PROCESSES IN MOSQUITOES WITH PARTICULAR REFERENCE TO Aedes aegypti. p. 185-200 of "Effects of Radiation on Meiotic Systems. Report of a Study Group. Vienna, Austria, 8 - 11 May 1967". Vienna, International Atomic Energy Agency. 1968, 223p.

The author has concentrated work on (1) the radiosensitivity of the meiotic and mitotic cycles and of various developmental stages; (2) the cellular and chromosomal basis of radiation- (and chemosterilant-) induced infecundity and sexual sterility in A. aegypti and the possible application of the sterile-male technique for mosquito control; the cytogenetics of radiation-induced heritable, chromosomal aberrations, e.g. reciprocal translocations, paracentric inversions and the evaluation of their potential for possible genetic control purposes; (4) the cytogenetics of sex-linked lethals induced by irradiation and chemosterilants; and (5) heterosis and radiation protection. - The paper stresses radiation-related methodology as it applies to mosquitoes in general and to A.aegypti in particular. Rearing procedures, irradiation and chemosterilant-treatment procedures, general cytological techniques, cytogenetic techniques for isolating specific chromosomal aberrations, and a technique for the detection of sex-linked, recessive lethals on chromosome I of A. aegypti are described.

964 Sado, T., Oishi, K. CYTOLOGICAL EVALUATION OF DOSE-RATE EFFECTS OF RADIATION ON MUTATION FREQUENCY OF SILKWORM GONIA. II. EVIDENCE OF G_2 ACCUMULATION OF PRIMARY SPERMATOGONIA AFTER ACUTE IRRADIATION. Mutation Res. 3, 6 (1966) 522-36.

The effects of acute irradiation on the kinetic indices of primary spermatogonia of the silkworm have been studied in an attempt to gain cytological insight into the mechanisms of dose-fractionation effects on the induction of mutation. (1) Kinetic studies, with the use of colchicine treatment and the ^{3}H-thymidine-labelling technique, on primary spermatogonial populations in unirradiated larvae showed that primary spermatogonia of this insect had a mean generation time of 34 h, of which the relative time occupied by the various phases of cell cycle was roughly as follows: G_1, ~40%; S, ~40%; G_2, ~18%; and M, ~2%. (2) Cytokinetic studies on the effect of acute irradiation (1000 R) on the population of primary spermatogonia showed that during the first 24 h after irradiation the relative frequency of cells in different phases of the cell cycle changed noticeably. Thus,

at 24 h as many as 58% of the total population was shown to be in the G_2 population in contrast to 18% of the unirradiated primary spermatogonial population. Furthermore, only 3%, instead of 40%, in the control, was in the S phase at this time. (3) It is tentatively concluded that enhanced mutation frequency in dose-fractionation experiments was primarily due to an increase in the relative frequency of cells in the G_2 population. However, the possibility remains that accumulation of cells in late G_1 might also be responsible for the enhancement of mutation frequency by dose frationations. (Auth. summary)

965 Sankaranarayanan, K. DOSE-RATE EFFECT IN THE REPAIR OF RADIATION DAMAGE IN SPERMATIDS OF Drosophila melanogaster. Mutation Res. 4 (1967) 222-224.

Mutation frequency was studied in D. melanogaster males exposed to low dose-rates of x-radiation under conditions of anoxia and followed by treatment with either nitrogen or oxygen. Frequencies of sex-linked lethals were not significantly different in the N_2- and the O_2-post-treated groups. Following irradiation, neither gas was effective in bringing about repair. (NSA 21: 1967, 20127)

966 Schwalm, F.E. ZELL- UND MITOSENMUSTER DER NORMALEN UND NACH RÖNTGENBESTRAHLUNG REGULIERENDEN KEIMANLAGE VON Gryllus domesticus. (Cell and mitotic patterns of the regenerating germ core of Gryllus domesticus in controls and after irradiation.) Z. Morph. Ökol. Tiere 55, 8 (1965) 915-1023.

The formation of the germ core (Keimanlage) was studied from the point of view of the time sequence, localization and growth. The effects of x-radiation showed that, after killing of the nuclear material in the anterior half of the egg with 2000 R, regulation of the germ core from the surviving nuclei may still occur after an irradiation of the core with up to 600 R. After whole-body irradiation up to 800 R reorganizing may cause the migration from anterior regions of nuclei which were no longer undergoing mitotis when they would be stimulated to renewed mitotic activity. Nuclei of the original germ core which were already in a less sensitive phase at the time of irradiation will resume mitotic activity. Following doses sufficient to kill all nuclei of the germ core a high degree of reorganization comes into effect. It is only possible by an interplay between nuclear material from the anterior non-irradiated egg half which has reached the germ area after irradiation, and the mitotis-stimulating and germ forming potency of the posterior irradiated half. These potent areas of yolk entoplasma systems are only negligibly disturbed by 1000 R at 48-49 h post-oviposition. The extent of irradiation damage is discussed. The migration processes involving nucleus aggregation and nucleus migration over the egg surface are not disturbed at 500 R at either 36 or 49 h. The mitosis-stimulating factors in the region of the germ core are highly resistant to radiation, and are able to stimulate mitosis and organise complete germ core after an irradiation of up to 1000 R.

967 Slizynski, B.M. DIFFERENTIAL x-RAY SENSITIVITY OF SPERMATOGONIA IN Drosophila melanogaster. Drosoph. Inf. Serv. 40 (1965) 48.

Slizynska found that in regard to the effects of irradiation there was a profound heterogeneity between males as well as between the germ cells of individual males in brood. Heterogeneity between the males would arise if at the time of treatment some males have more spermatogonial mitoses than the others. Heterogeneity between the germ cells of individual males can be reduced to the fact that in the testis some spermatogonial cells are in a susceptible stage (metaphase) while the majority of cells are in a resistant stage. The question was studied cytologically and the following results were obtained. Among 129 2-3 d-old males of y w stock there were 25 males in which there were no mitotic divisions in the testes, 23 males had mitoses in the apex cells and 81 males had spermatogonial mitotic divisions in the cysts. Among the males of this last category there were 51 with 4 or less dividing spermatogonial cells, 14 males with 5-7 divisions per testis, and 16 males with 8-16 divisions of spermatogonial cells per testis. Thus the highest sensitivity to treatment in brood is expected to occur in about 12% of males. This figure will be doubled if two last classes of frequency of mitoses are taken as resulting in high sensitivity. (Auth.)

968 Smith, R.H., Whiting, A.R. x-RADIATION SENSITIVITY OF Habrobracon OOCYTES AT DIAKINESIS. Genetics 54, 1 Pt.1 (1966) 364. Paper presented at the "1966 Meetings of the Genetics Society of America, Chicago, Ill., USA. 1-3 Sep. 1966".

The complex nature of prophase I in meiosis requires that, for greatest significance of irradiation studies, the exact condition of the chromosomes at time of exposure be determined. Previously

reported tests of Habrobracon oocytes have demonstrated the high resistance of earlier stages in prophase I and the high sensitivity of oocytes in metaphase I, a ratio of 20 to 1. We focus our attention here on the sensitivity of diakinesis. The Habrobracon female has four ovarioles, each ending posteriorly in a uterine sac. A well-fed female restrained from oviposing for 16 h has in each uterine sac four eggs in the first meiotic metaphase and one in diakinesis. Previous studies have demonstrated that an exposure of 2000 R or 2500 R, sufficient to induce dominant lethal changes in over 99% of eggs in metaphase I, has imperceptible effects on oocytes in prediakinesis stages. In the present experiment, hatchability and times of death of embryos were followed closely over six, short, egg-laying intervals. By cytological examination, the maximum number of metaphase I eggs per female was found to be 16, as expected. At the exposures used (2000 R and 2500 R), the number of non-hatching eggs exceeded this max. number in 59 out of 113 females. The average number of non-hatching eggs exceeding the 16 egg max. was 19 and the range was up to 23 eggs/female. Therefore, the diakinesis stage is in the same range of radiation sensitivity as the 1st meiotic metaphase. (Auth.)

969 Smith, R.H., Whiting, A.R. x-RADIATION SENSITIVITY OF Habrobracon OOCYTES AT DIAKINESIS. p. 62-63 of "Biology Division Semiannual Progress Report for Period Ending July 31, 1966". ORNL-3999, Oak Ridge National Lab., Tenn. 1966, 217p.

For abstract, see 968.

970 Sobels, F.H. OXYGEN DEPENDENT DIFFERENCES IN RADIOSENSITIVITY BETWEEN FULLY MATURE AND ALMOST MATURE SPERMATOZOA. Drosoph. Inf. Serv. 41 (1966) 150.

x-irradiation S in O_2, (2000 R), air (3000 R) or N_2 (4000 R) were carried out to investigate whether these differences in radiosensitivity between fully mature, motile spermatozoa and the immotile, late spermatids (in Lefevre's terminology) are associated with differences in oxygenation. The most radiosensitive kind of sperm was sampled by using the first ejaculate from 7-d-old males. Sperm with lowest sensitivity was obtained from the first ejaculate of 1-h-old males. After radiation exposures in O_2 and N_2, post-treatments with N_2 or O_2 were given, after irradiation in air with N_2 or air. The pooled results from a number of (tabulated) replica experiments show that considerably higher mutation frequencies were only obtained for sperm from 7-d-old males after irradiation in air than from 1-h-old males; X^2 of the difference is 9.41, with $P < 0.003$. After radiation in O_2, the radiosensitivity in sperm of 7-d-old males was not significantly higher than in that from 1-h-old males, and a similar result was obtained after irradiation in N_2. The O_2-enhancement ratio under comparable conditions of post-treatment, and this radiosensitivity in the presence of O_2, is only slightly higher for sperm in 7-d-old males than for that in 1-h-old males. The pronounced differences in sensitivity after radiation in air therefore clearly originate from a greater availability of O_2 for sperm in the old than for that in the young males, and a priori it is not unlikely that similar causes underly the differences in sensitivity of successive ejaculates derived from 3-d-old males. The present results confirm an earlier conclusion by Oster (see II/1096), based on observations for 1st- and 2nd-day sperm.

971 Stømnaes, Ø. RADIATION GENETICS. A REVIEW. Hereditas 52 (1964) 241-242. Abstr. Paper presented at the "3rd Meeting of the Scandinavian Association of Genetics. Helsinki, Finland, 10-12 Jun. 1964".

The radiosensitivity of the different stages of spermatogenesis and oogenesis was discussed, and also the effect of irradiation in different atmospheres. Fractionation and protraction of radiation dosages were also considered. Data published on the sensitivity of spermatogonia may indicate differential sensitivity regarding mutability and viability, while other data indicate that there may exist positive as well as negative males with respect to induction of mutations in spermatogonia. This problem and the problem of recovery in mature sperm were discussed at some length. The effects of chemicals, especially of protein synthesis inhibitors were outlined. The review covered also the effect of temperature during irradiation, and pointed out misinterpretations that may be made if the killing effect of irradiation is overlooked. Finally, new lines of attack on the radiation problem were suggested. (From abstr.)

972 Sugai, E., Tadahiko, I. DOSE RATE EFFECT OF RADIATION ON SPERMATOGONIA OF THE SILKWORM. Nature, Lond. 213 (1967) 943-944.

Silkworm spermatogonia are readily killed by acute irradiation. The effect of dose rate and repopulation of spermatogonia is cytologically analysed with particular reference to possible selective elimination of the cells after exposure to different dose rates of radiation. The extent of spermatogonial death and the number of surviving or newly formed cells was approximately similar at the two very different dose rates used, except for the initial cell degeneration after the exposures. For chronic irradiation, ^{60}Co γ-rays were administered continuously for 122 h for 5-10 d post hatching, total dose 1000 R at 0.136 R/min; acute irradiation was carried out 7 d after hatching, at 200 R/min for 5 min. (Larval testes were fixed and stained every 24 h after initiation of chronic irradiation or completion of acute irradiation. Selection was found not to be involved in the dose-rate effect on mutation frequency in the spermatogonia. Surviving spermatogonia remain in a state of arrest for several days after irradiation.

973 Suomalainen, H.O.T., Petäjä, T.E. THE EFFECT OF x-RADIATION ON THE SPERMATOGENESIS IN CERTAIN GRASSHOPPERS. p. 216 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun. - 2 Jul. 1966, 263p". Abstr. 859.

x-rays generated at 50 kV with an intensity of 180 - 600 R/min were used as total body irradiation of male grasshoppers representing the following species: Chorthippus elegans, Ch. parallelus, Omocestus viridulus, Gomphocerus maculatus, and Mecostethus grossus. The dose range was from 90 R - 9 kR. The testes were fixed at intervals of 1 - 14 d after irradiation and examined as paraffin sections or Feulgen squashes. The distribution of different types of chromosomal effects was used in an attempt to determine the radiation sensitivity of the different meiotic stages. The initial process of meiosis seemed to be inhibited at pachytene, since diplotene and diakinesis stages were virtually absent after the higher doses. On the other hand, the occurrence of certain types of chromosomal rearrangements shows that the meiotic divisions were not suppressed by the lower doses. Of special interest was the occurrence of an abnormal ball type of metaphase which can be clearly distinguished from ordinary pycnosis or karyolysis. This particular effect in which the often heavily fragmented chromosomes are drawn together in the centre of the nucleus, was generally seen as a uniform response of whole cysts of spermatocytes in the 1st or 2nd meiotic division. (Abstr.)

974 Tazima, Y., Sado, T. POST-IRRADIATION MODIFICATION AND A POSSIBLE MECHANISM OF THE REVERSE DOSE-RATE EFFECT ON MUTATION INDUCTION OBSERVED IN SILKWORM GONIA. p. 220 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun. - 2 Jul. 1966, 263p." Abstr. 875.

An enhancing effect on radiation-induced mutation was observed in the silkworm after fractionated exposure of gonial cells. As a possible interpretation of this phenomenon a kind of modification in cellular metabolism was assumed. The modified state, which is detectable by increased mutation frequency, persists at least for 48 h and is characterized by a peak appearing 18-24 h after the initial exposure. The non-decay type curve suggests that this is not due to a biochemical disturbance but presumably to cell synchronization. The results of an experiment, where two split doses were given to two experimental series in reciprocal order (250 R + 750 R and 750 R + 250 R) 6 h apart up to 48 h, showed that the peak appears earlier for the initial 250 R than for the initial 750 R series. By labelling S phase cells with ^{3}H-thymidine, Sado observed that irradiated cells are blocked in their progression at G_2 and their proportion increases remarkably in the cell population. These results favour the hypothesis of the cell synchronization. If this were the case, decrease in mutation frequency could also be detected when a 2nd irradiation is given at an appropriate interval after the initial exposure. This, however, was not observed up to 72 h interval, suggesting that synchronization, if occurred, is destroyed immediately in the subsequent cell cycle. Presumably the cells are released from the blockade at a reduced rate. Based on those results we examined the validity of the same mechanism for the interpretation of the reversed type dose-rate effect. Cytological observation revealed that the mitotic process of gonia at a late stage is inhibited, being blocked at G_1 and G_2, during chronic exposure. Furthermore, it was confirmed genetically that the chronic treatment becomes more effective for mutation induction than the acute one as early as 1 d after hatching, coinciding with the initiation of cellular activity. This observation explains why dose-rate effect is reversed within a very short period. (Abstr.)

975 Tazima, Y. CHANGES IN THE MUTATION RESPONSE OF POST-MEIOTIC SILKWORM GERM CELLS TO γ-RAYS WITH THE PROGRESSING SPERMIOGENESIS. Rep. nam. Inst. Genet., Misima No. 17 (1966) 97.

976 Tikhomirova, M. M. COMPARATIVE STUDY OF THE RADIOSENSITIVITY AT DIFFERENT STAGES OF OOGENESIS. Genetika No. 6 (1967) 24-32. (In Russian)

It was shown by a comparative study of the radiosensitivity at the different stages of oogenesis of Drosophila, carried out by means of the comparison of the frequency of the cases of X-chromosome loss as the result of breaks, that at least three groups of cells could be distinguished: the most radiosensitive 14-stage oocytes; the less sensitive early oocytes at other stages; and the nonsensitive oogonia. The potential damages in the 14-stage oocytes were shown to be repaired under normal conditions. The course of the repair was not uniform; thus most damages were repaired during the first 30 min after the irradiation, but some persisted for more than an hour. During the period of 0.5 - 8.5 h after the irradiation the aftereffect was proportional to the duration of the exposure to high temperature: i.e., the realization of the potential damages under high temperature was uniform in character. In early oocytes (7 - 13 stages) the aftereffect of radiation could be detected only after a long period (8 h) of temperature treatment, which was indicative of their higher reparative ability as compared to the 14-stage oocytes, and of the similarity of breaks (with respect to the duration of the time during which they remained open) at these stages. No perceptible aftereffect of radiation was observed in oogonia which was probably associated with the elimination of the damaged oogonia during the meiosis. The study of the x-radiosensitivity by means of the comparison of the frequency of the non-disjunction of X-chromosomes revealed no differential sensitivity of gametes in oogenesis. (Auth.)

977 Traut, H. REPAIR OF GENETIC RADIATION DAMAGE: A POSSIBLE CAUSE OF DIFFERENTIAL RADIOSENSITIVITY IN Drosophila melanogaster. p. 67-78 of "Genetical Aspects of Radiosensitivity: Mechanisms of Repair. Proceedings. Vienna, Austria. 18-22 April 1966". STI/PUB/130. International Atomic Energy Agency, Vienna 1966, 175p.

The extent to which differential radiosensitivity in gametogenesis of D. melanogaster can be explained by metabolic repair of premutational damage (including the rejoining of radiation-induced chromosome breaks) is discussed. Three stages of gametogenesis are considered, in which repair might occur: late spermatids ("immature sperm"); the gonial stage (both of spermatogenesis and oogenesis); and prophase I-oocytes. Experimental proof is given that there is no repair by storing of mature sperm. An hypothesis is proposed to explain the striking differences observed for the dosage-effect-relations for dominant lethal induction in metaphase I ("stage 14") and prophase I ("stage 7") oocytes, respectively. This hypothesis is partly based on differential repair (restitution) of chromatid breaks in these two oocytic stages. The implications of the low radiosensitivity of gonia and early oocytes for radiation damage to human germ cells are briefly considered. (Auth.)

978 Traut, H. RADIO-INDUCED MITOTIC DELAY IN SPERMATOGENESIS OF Drosophila melanogaster. Nature, Lond. 209 (1966) 92-93.

Careful examination of the results obtained by Welshon and Russel (Proc. natn. Acad. Sci. U.S.A. 43: 1957, 608) in their histological observations on the testis of x-irradiated adult D. melanogaster indicates a mitotic delay in addition to cell-killing induced by x-rays. The author (H. T.) implies that radiation-induced mitotic delay, as well as cell killing and dominant lethality, contributes to the sterile interval observed in brood pattern experiments, using irradiated Drosophila males.

979 Truckenbrodt, W. SENSIBILITÄT UNDIFFERENZIERTER UND DIFFERENZIERTER KERNE NACH RÖNTGENBESTRAHLUNG IN DER FRÜHEN EIENTWICKLUNG DER TERMITE Kalotermes flaviocollis Fabr. (The sensitivity of undifferentiated and differentiated nuclei following x-irradiation in the early stage of development of the egg of the termite Kalotermes flavicollis Fabr.) Wilhelm Roux Arch. EntMech. 156, 2 (1965) 101-126. (In German)

Eggs were irradiated between cleavage and end of the blastular stage. Cellular lesions vary with the moment in mitosis at which irradiation occurs (e.g. metaphase is very sensitive). The blastomeres are more sensitive than the micromeres. Doses leading to immediate and deferred death are discussed.

980 Vatti, K. V. DEPENDENCE OF MUTATION FREQUENCY ON THE x-RAY DOSAGES IN THE SENSITIVITY OF PREMEIOTIC AND POSTMEIOTIC STAGES OF SPERMATOGENESIS. Genetika No. 4 (1965) 94-99. (In Russian)

The frequency of sex-linked recessive lethal mutations was studied in Drosophila sperm and spermatogonia exposed to 100-3000 R doses of x-rays. The data obtained indicate a linear relationship

between dosage and frequency of induced mutations in mature sperm. In spermatogonia the mutation rate shows a complicated characteristic ascribed to the heterogeneity of the spermatogonial stages. At low (0 - 300 R) and high (1200 - 3000 R) doses, a linear relationship was noticed that reflects the real frequency of the corresponding sensitive and unsensitive fractions of spermatogonia. At mild doses (300 - 1200 R) the dependence of mutation rate on dosages of x-rays disappeared due to the death of sensitive cells within which a mutation was induced (germinal selection). At low doses spermatogonia (sensitive fraction) are more sensitive than mature sperms. At mild and high doses the frequency of mutation in mature cells is higher than in immature ones. (Auth.)

981 Westerman, M. THE EFFECT OF x-IRRADIATION ON MALE MEIOSIS IN Schistocerca gregaria (Forskal). I. CHIASMA FREQUENCY RESPONSE. Chromosoma 22, 4 (1967) 401-416.

The pattern of response of chiasma frequency to x-irradiation was studied in germ line cells of male imagines of S. gregaria. ^{3}H-thymidine was used to mark cells undergoing DNA synthesis at the time of irradiation. It was injected abdominally (~10 µCi in 0.02 ml of water). A correlation has been established between the observed changes in chiasma frequency of the L and M type bivalents and the time in the meiotic cycle at which the treatment is given. Two radiosensitive periods have been identified in meiosis itself. At one (meiotic DNA synthesis) x-irradiation produces a decrease in chiasma frequency while at the other (leptotene-early zygotene) the treatment leads to an increase in chiasma frequency. Small bivalents however do not respond to treatment and form a single chiasma under all conditions.

982 Whiting, A.R., Smith, R.H., Borstel, R.C. von METHODS FOR RADIATION STUDIES DURING OOGENESIS IN Habrobracon juglandis (Ashmead). p.201-208 of "Effects of Radiation on Meiotic Systems. Report of a Study Group. Vienna, Austria, 8-11 May 1967". Vienna, International Atomic Energy Agency. 1968, 223p.

Review. The particular suitability of Habrobracon for this work is stressed. Eggs were placed with a larva of Ephestia kühniella as food supply. Hatchability, adult survival, classification of stages of death, and separation of meiotic stages by timed intervals of egg-laying are discussed from the experimental point of view. When females are irradiated, clusters of eggs are laid which, by accurate timing, can be placed in homogeneous categories of oocytes irradiated in the 1st meiotic metaphase (I), diakinesis, and the earlier 1st meiotic prophase (presumably diplotene) stages. Since diakinesis is in the same range of sensitivity as the 1st meiotic metaphase, it is often convenient to compare only the sensitive metaphase I and the resistant prophase I. In most experiments the females are bred unmated, so the criterion is not that of dominant lethality per se but that of total dominant and recessive lethality. Recessive lethal mutations, inherited partial sterility, sterility, visible mutations, sterility and semisterility are discussed. Estimation of genetic parameters, in particular, accurate methods for estimating the dominant lethality and recessive lethality in Habrobracon are made by using certain equations. As for stage sensitivity, for dominant and recessive lethality induced by x-rays, metaphase I was found to be 20 times more sensitive than prophase I. Translocations are formed rarely among chromosomes of irradiated oocytes. A sterile period has been found to occur between the 5th to 8th day which separates oogenesis from the oogonial period. Dominant lethals are present in eggs that had been irradiated as oogonia. The balance of meiosis resembles metaphase I in sensitivity to x-rays. When DNA synthesis begins at late telophase of the 2nd meiotic division, the nucleus becomes extremely sensitive, and the late prophase (G_2) of mitosis is extremely resistant; the metaphase of 1st meiosis has about the same sensitivity as metaphase I of meiosis.

983 Wu, C.K. MEIOTIC X-Y EXCHANGE AND NONDISJUNCTION INDUCED BY x-RAYS IN PRIMARY SPERMATOCYTES OF MALE Drosophila melanogaster. Diss. Abstr. 28, 1 (1967) 57-B - 58-B.

In the present experiments, males bearing the doubly marked Y-chromosome, B^{S} Y y^{+}, and singly marked Y-chromosome, y^{+}Y, were x-rayed, in separate experiments, as prepupae and adults, while Y w^{+}-bearing males were x-rayed as prepupae only. x-rayed adult males were brooded daily with three virgin females for 10 d, and males irradiated as prepupae for 4-6 d. Untreated males brooded in the same manner served as controls. An increase in the frequency of X-Y exchange and of X-Y non-disjunction was observed in those broods corresponding to the primary spermatocyte stage at the time of irradiation. In all experiments x-irradiation of primary spermatocytes of both immature and mature testes was shown to yield a greater proportion of X-Y exchanges than X-Y non-disjunctionals. The present work confirms Zimmering's preliminary results (unpublished) that after irradiation of the

prepupal testis more cases of X-Y exchange than X-Y non-disjunction were recovered. From experiments in which the doubly marked Y-chromosome, $\underline{B}^S$ Y $\underline{y}^+$ was employed, the spontaneous frequency of X-Y^S exchange was higher than that of X-Y non-disjunction. With the singly marked Y, $\underline{y}^+$ Y, non-disjunction exceeded exchange. The reason for this difference with the two types of Y-chromosomes is not clear, although it may be possible that (1) XXY non-disjunctionals, hyperploid for both $\underline{y}^+$ and $\underline{B}^S$, may be less viable than those hyperploid for $\underline{y}^+$ alone, and / or (2) since the $\underline{B}^S$ Y $\underline{y}^+$ carried the $\underline{y}^+$ allele on Y^S, and its associated X-derived heterochromatin, pairing of Xh and Y^S may be facilitated resulting in fewer nondisjunctional cases of X and Y as well as favoring the rejoining of spontaneous breaks leading to exchange. It was observed that the spontaneous frequency of X-Y^S exchange is higher than that of X-Y^L exchange. On the other hand, approximately equal frequencies of induced exchanges between X and Y^S and X and Y^L were recovered in doubly marked Y experiments. It was found that in the doubly marked Y experiments, immature testes treated with x-rays yielded more X-Y exchanges than the treated mature testes. The testes at prepupal stage may possess a larger cell population of primary spermatocytes than the adult. The spontaneous and induced frequencies of XXY females, as compared with that of XO males and that of X-Y exchange females, are relatively low. The possible bearing of the Peacock and Erickson's hypothesis (1965) on the interpretation of these observations is discussed. (From DA)

984 Würgler, F.E. INDUCED MUTATIONS AND LETHALITY IN Drosophila AFTER x-IRRADIATION OF MEIOTIC AND POST-MEIOTIC STAGES OF THE EGG. p. 43-62 of "Effect of Radiation on Meiotic Systems. Report of a Study Group. Vienna, Austria, 8-11 May 1967". Vienna, International Atomic Energy Agency. 1968, 223p.

In radiobiological experiments with new-laid eggs and young embryos of D. melanogaster the role of nuclei and chromosomes in radiation-induced death has been analysed. The predominant role of the nuclei was demonstrated by means of partial irradiation of uncleaved eggs which showed that the region of highest radiosensitivity corresponds with the region containing the nucleus. This was further corroborated by the findings that radiosensitivity can be correlated with the nuclear division stage and the number of nuclei present at the moment of irradiation. The correlations with nuclear division stages are different for induced lethality and for specific types of mutations (sex-linked lethals and reciprocal translocations). Assuming that chromosomal damage is an important factor in radiation-induced lethality, we postulated that other types of chromosomal changes contribute also to lethality, e.g. induced breakage-fusion-bridge cycles, with still another correlation with nuclear division stages. Preliminary results on the radiosensitivity of different genotypes indicate that the above assumption can probably be tested experimentally. (Auth.)

985 Ytterborn, K.H. RATES OF AUTOSOMAL RECESSIVE LETHALS AFTER x-RAY TREATMENT OF SPERMATOGONIA AND SPERMATOZOA IN Drosophila melanogaster. Hereditas 58, 1-2 (1967) 165-190.

Adult males were irradiated, then mated for 4 h in order to test the incidence of IInd-chromosome recessive lethals in spermatozoa. To test the effects of irradiation on spermatogonia, 17-h-old larvae were irradiated. After eclosion males were mated in six consecutive periods. Male progeny from two of these matings, 0-3 d and 15-18 d respectively after eclosion, were sampled for tests of lethals. The dose used was 900 R x-rays. The total mutational damage when measured as frequencies of chromosomes with lethals is similar in the two tests from irradiated spermatogonia. The incidence of independent lethal mutations, however, is higher in the period 0 - 3 d than in the period 15 - 18 d while the average cluster size is larger in the last period than in the first. The distributions of independent lethal mutations among males in the two spermatogonia series do not deviate from Poisson expectations. The spermatogonia of different males therefore seem to be equally sensitive. The frequency of chromosomes with lethals was found to be about three to four times higher after irradiation of spermatozoa than after the same treatment of spermatogonia. (From auth. summary)

986 Zimmering, S., Wu, C.K. MEIOTIC X-Y EXCHANGE AND NONDISJUNCTION INDUCED BY IRRADIATION IN THE Drosophila MALE. Genetics 50 (1964) 633-638.

D. melanogaster males of the composition $\underline{yv}/\underline{y}^+Y$ were x-rayed as prepupae and mated upon eclosion to $\underline{yv}$; $\underline{bw}$ females. The phenotypically vermilion female offspring which were non-

yellow were tested further using a genetic scheme which permitted an unequivocal distinction between those that arose following X-Y non-disjunction and those that arose following X-Y^s exchange. The results from these tests demonstrated that X-Y^s exchanges are recovered appreciably more frequently than X-Y non-disjunctionals with ratios as high as 6-7:1, and disclosed a class of exceptional females interpretable as having arisen from the recovery of Y-autosome translocations induced in primary spermatocytes. Applying a correction for the occurrence of these translocations not tested in previous prepupal experiments involving the B^sYy^+ the ratios of induced X-Y^s exchanges to non-disjunction nonetheless turn out to be as high as those found in the present experiment. It seems likely that the explanation for the sharp disagreement between these results and those reported by Sävhagen (1961) is related to the difference in the genetic test used to distinguish between these two kinds of females, with only the present test being critical. (Auth.)

See also :

20 The so-called recovery phenomenon after irradiation in Drosophila melanogaster. (Trout, W.E., III., 1966)
248 Somatic mutations in the moth Ephestia. Report on Research, August 1, 1964-September 1, 1967. (Caspari, E.W., 1967)
921 Cytogenetic analysis of lethal mutation induced during different stages of spermatogenesis in Drosophila. (Khashim-Akhmed, M.S., 1965)
924 Cytological studies on the radiosensitivity of spermatogonia of the silkworm. (Nakanishi, Y.H. et al., 1965)
927 A cytological study of radiation effects in testes of the screw-worm fly, Cochliomyia hominivorax (Diptera: Calliphoridae). (Riemann, J.G., 1967)
928 Cytological evaluation of dose-rate effects of radiation on mutation frequency of silkworm gonia. I. Kinetics of proliferation and killing of spermatogonia during chronic irradiation. (Sado, T., 1966)
997 Studies of early effects of radiation on chromosomes and mitosis. Progress Report, March 1, 1966-February 28, 1967. (Carlson, J.G., 1967)
1001 The effects of x-rays on the chromosomes of locust embryos. II. Chromatid interchanges and the organization of the interphase nucleus. (Fox, D.P., 1966)
1002 The effects of x-rays on the chromosomes of locust embryos. III. The chromatid aberration types. (Fox, D.P., 1967)
1003 The effects of x-rays on the chromosomes of locust embryos. IV. Dose-response and variation in sensitivity of the cell cycle for the induction of chromatid aberrations. (Fox, D.P., 1967)
1011 Induced crossing-over in the males of Drosophila ananassae: exchanges mainly in spermatocytes of adults. (Kale, P.G., 1967)
1016 Early chromosomal response to x-rays. (Leach, W.M. et al., 1966)
1017 Lack of x-ray induced chromosome "stickiness" in grasshopper neuroblasts. (Leach, W.M., 1967)
1019 Genetic crossing over in both sexes of Megaselia scalaris. (Mainx, F. et al., 1967)
1024 Inheritance of radioresistance in Drosophila. (Ogaki, M. et al., 1966)
1027 Identification of the proposal: x-ray induced changes in Drosophila germ cells. Progress Report, September 1, 1965-August 31, 1966. (Rinehart, R.R.)
1045 On frequency of x-ray-induced chromosome breaks at various stages of Drosophila melanogaster spermatogenesis. (Vatti, K.V., 1966)
1058 Radiation induced tandem duplications in Drosophila melanogaster. (Bender, H.A., 1967)
1062 Dependence of radiation induced mutation rate on maturity and dose for chrysalis of Drosophila melanogaster Meigen. (Ebeling, W., 1962)
1088 Segregation of tritium-labeled DNA at meiosis in Chorthippus. (Moens, P.B., 1966)
1091 Enhancing effect of fractionated irradiation with 14 MeV neutrons on the induction of visible recessive mutations in silkworm gonia. (Murakami, A. et al., 1966)
1139 Sterility, chromosome breakage, x-ray-induced mutation rates and detected mutation frequencies in Drosophila melanogaster. (Lefevre, G., Jr., 1967)
1188 Fast neutron and x-ray irradiation of Drosophila melanogaster oogonia and oocytes. (Dickerman, R.C., 1967)
1189 Mutational response of Drosophila melanogaster oocytes and oogonia to x-ray and fast neutron irradiation. (Dickerman, R.C., 1967)

1201 Investigations on the influence of 5-bromouracildesoxyriboside (BUdR) on the radioinduced mutation rate in Drosophila melanogaster. (Magdon, E. et al., 1967)

1212 The potentiating effect of sodium fluoride on the induction of mutations by x-rays in mature spermatozoa of Drosophila melanogaster. (Mukherjee, R.N., 1967)

1220 X-ray induced changes in Drosophila germ cells. Three-Year Comprehensive Report September 1, 1964- August 31, 1967. (Rinehart, R.R., 1967)

1229 Sensitivity differences in the successive stages of spermatogenesis in Drosophila after irradiation in nitrogen or air. (Shiomi, T., 1967)

1234 The contrasting effects of O_2 and N_2 in determining initial sensitivity and post-radiation recovery in Drosophila sperm and spermatids. (Sobels, F.H., 1964)

1235 Processes underlying repair and radiosensitivity in spermatozoa and spermatids of Drosophila. (Sobels, F.H., 1966)

1242 Post-radiation recovery in early spermatids and spermatocytes sampled from Drosophila pupae. (Watson, W.A.F., 1966)

1243 Post-radiation recovery in spermatids sampled from 24 hr old pupae of Drosophila melanogaster. (Watson, W.A.F. et al., 1967)

1244 Post-radiation recovery in early spermatids sampled from Drosophila pupae. (Watson, W.A.F., 1967)

1246 Genetic x-radiation damage and its modification by some gases and a time factor in Drosophila melanogaster. (Yoon, J.S., 1967)

1265 Mutagenesis at a complex locus in Drosophila with the monofunctional alkylating agent, ethyl methanesulfonate. (Jenkins, J.B., 1967)

1271 Relative biological effectiveness of 14 MeV neutrons to gamma-rays for inducing mutations in mature sperm of the silkworm. (Murakami, A., 1966)

1327 Midgut epithelium of adult Chelisoches morio (Dermaptera: Chelisochidae) and Ceratitis capitata (Diptera: Tephritidae) following ionizing irradiation. (Little, H.F., 1967)

1328 Effet des rayons x sur l'intestin moyen de Blabera fusca Br. (Mortreuil-Langlois, M., 1960)

1329 Histopathological study of the midgut of Blabera fusca Br. (Orthoptera) over an extended post-irradiation period. (Mortreuil-Langlois, M. 1963)

1331 Irradiation effects on midguts and testes of the adult boll weevil, Anthonomus grandis, determined by histological and shielding studies. (Riemann, J.G. et al., 1967)

1343 Applications of genetic technology to mosquito rearing. (Craig, G.B., Jr., 1964)

1370 Variation in radiosensitivity during the early developmental stage of the silkworm egg. (Murakami, A., 1966)

1386 Biochemical and developmental response of grasshopper embryos and spermatogonia to x-irradiation. (Tahmisian, T.M., 1965)

1388 Récentes expériences de radiobiologie sur Bombyx mori. (Teulade, P., 1966)

1425 Lifespan studies with strains of gamma-irradiated Drosophila adults. (Sonnenblick, B.P. et al., 1967)

2.1.4. Chromosome Aberrations and Damage to Cellular Organelles (including Breakage, Crossing-Over, Large Deletions, and Translocations)

987 Akhalaya, Y.G. ETUDE DE L'EFFET GENETIQUE DES RAYONNEMENTS IONISANTS CHEZ LE VER A SOIE. Soobshch. Akad. Nauk, gruz. SSR 48, 2 (1967) 449-454. (In Georgian, with Russian summary)

988 Amy, R.L., Borstel, R.C. von. TIME OF DEATH OF A TRANSLOCATION SEGREGANT IN Habrobracon. p. 63 of "Biology Division Semiannual Progress Report for Period Ending July 31, 1966". ORNL-3999, Oak Ridge National Lab., Tenn. 1966, 217p.

Translocation can be induced by x-raying Habrobracon males, and detected by inherited partial sterility methods. It would appear that the particular translocation involves a part of the genome that exerts its influence during the last one-third of the 29-h embryonic period.

989 Arnheim, N., Jr. THE REGIONAL EFFECTS OF TWO MUTANTS IN Drosophila ANALYZED BY MEANS OF MOSAICS. Genetics 56, 2 (1967) 263-283.

The genes Tufted and l(1) N^B have rather extensive regional effects on the differentiation of the mesonotal bristles in D. melanogaster. The former adds macrochaetae to the posterior mesonotal region while the latter removes numerous microchaetae from the mesothorax. For mosaic production, larvae of the genotypes y^+ Tft/() Tft^+ were irradiated, on Petri dishes containing standard Drosophila medium, 24–48 h after hatching. This led to an increase over that occurring spontaneously, in the frequency of somatic crossing over. A dose of 1500 R, at 75 R/min, was delivered for 20 min. All experiments were conducted at 25 ± 1°C. After emergence flies were inspected for mosaic patches. An analysis of genetic mosaics has shown that both of these mutations affect the competence of cells in specific regions of the mesonotum to initiate and/or complete bristle differentiation. The extreme phenotype manifested by individuals carrying these mutations therefore is not the result of a change in the underlying prepattern.

990 Asman, M. CYTOGENETIC AND DEVELOPMENTAL EFFECTS OF GAMMA-IRRADIATION ON Aedes aegypti (L.). Thesis. Notre Dame Univ., Ind. 1966, 112p.

991 Bateman, A.J. x-IRRADIATION OF HETEROZYGOUS ATTACHED-X. Drosoph. Inf. Serv. 40 (1965) 79.*

The attached-X used had arisen in progeny from sc ec cv/ct v g ♀♀ which had been irradiated. It was homozygous for sc ec and cv, and heterozygous for ct v and g. ♀♀ were irradiated with 4000 rad or kept as unirradiated controls. The progeny of eggs laid on days 7–11 after irradiation were scored for homozygosis for ct v and g, the results being tabulated. 4000 rad produce a 3-fold increase in c–o between g and the centromere. The increase in homozygosis for v is the same as for g, meaning that there has been no change in c–o between v and g. The absence of any change in homozygosis for ct means that c–o between ct and v must have decreased by an amount equal to the increase proximal to g. These results confirm those presented in DIS 37 : 68 in respect of segments ct - v - g and add the additional information that x-rays enhance c–o near the centromere (to the right of g). The controls show relatively low homozygosis for ct. This is in all probability due to some parental attached-X ♀♀ being homozygous +ct. (From auth.)

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* See also a longer paper (III/529) on "Effects of x-rays on female germ cells of Drosophila melanogaster. II. Crossing-over in the X-chromosome", which includes these data.

992 Bateman, A.J. NON-DISJUNCTION AND ISOCHROMOSOMES FROM IRRADIATION OF CHROMOSOME 2 in Drosophila. p.63-70 of "Effect of Radiation on Meiotic Systems. Report of a Study Group. Vienna, Austria, 8-11 May 1967". Vienna, International Atomic Energy Agency. 1968, 223p.

Using a stock of Drosophila in which chromosome II is represented as two isochromosomes, a study has been made of the induction of non-disjunction (and loss) of chromosome II in ♀♀ by x-rays. At the same time it was found that there was a high yield (one quarter of all progeny) of induced isochromosomes. There is a high yield of all classes of progeny from irradiated oocytes and a lower yield from irradiated oogonia and stem cells. The fractionation of the progeny into the various classes is independent of the stage of oocyte. Oogonia give relatively few nullisomic progeny when compared with oocytes. 90% of the disomic progeny from oocytes arise from 1st-division non-disjunction. There is evidence that at 2nd division the disjunction of the two half-bivalents is not random. Most of the disomic progeny from oogonia have arisen via asynapsis which, paradoxically, is accompanied by increased crossing-over in the normal progeny. Phenotypic analysis of the isochromosomes shows that ¼ contain sister centromeres compared with the expectation, with random association, of ⅓. The mode of origin of isochromosomes, and its relevance to sister strand exchange in meiosis, are discussed. The ease of reconstruction of normal chromosomes from isochromosomes also has bearing on the mode of origin. (Auth.)

993 Bauer, H. DIE KINETISCHE ORGANISATION DER LEPIDOPTEREN-CHROMOSOMEN. (The kinetic organization of lepidopteran chromosomes.) Chromosoma 22, 2 (1967) 101-125. (In German, with English summary). Also published as ORNL-tr-1817, Oak Ridge National Lab., Tenn. nd, 38p.

In monokinetic chromosomes half of the recombinations from reciprocal translocation are expected to be lethal owing to the formation of bikinetic and akinetic chromosomes. In holokinetic chromosomes all reciprocal recombinations should be viable, because all again are holokinetic. This difference can be used as a tool other than the study of fragment behaviour to decide which type of chromosome

is present in an animal species. — Pieris brassicae males x-rayed with 6000 R units and mated to normal females gave in F_1 only 19.9% lethal zygotes (14.7% of which dying late) as compared to a control mortality of about 7.7%. Among the hatched male caterpillars cytologically tested in the last larval instar 64.9% contained in their spermatocytes 1 - 4 heterozygous translocation rings or chains consisting of from 5 - 14 chromosomes. Translocations of similar frequency and even greater complexity have been observed in preliminary experiments on Philosamia cynthia. — The discrepancy between these results and those on species with monokinetic chromosomes (Drosophila, Phryne etc.) where very high zygotic lethality is observed at comparable R. doses is proof of the holokinetic nature of Pieris and Philosamia chromosomes. Together with earlier results on Bombyx mori by Astaurov and Frolova and the cytogenetic studies especially by Seiler, sufficient proof exists to conclude that all Lepidoptera have holokinetic chromosomes. — A survey of the known groups of organisms with chromosomes of this type leads to the assumption that holokinetic chromosomes must be derived from monokinetic ones. The problems connected with this change in kinetic organization of chromosomes are discussed. (Auth.)

994 Beermann, W. OPERATIVE GLIEDERUNG DER CHROMOSOMEN. (Functional organization of chromosomes.) Naturwissenschaften 52, 13 (1965) 365-375. (In German)

Review article, citing numerous autoradiographic studies.

995 Brito da Cunha, A., Magalhães, L.E. de, Toledo, J.S. de, Toledo, F°., S.A., Souza, H.L. de, Pavan, C. CONTRIBUTION TO THE UNDERSTANDING OF THE DYNAMICS OF LETHAL CHROMOSOMES IN POPULATIONS OF Drosophila willistoni p.198 of "Dynamics of Populations, Quantitative Genetics, and Breeding. International Symposium of Genetics. São Paulo, Brazil. Aug. 1966".

996 Carlson, J.G. ELECTRON MICROSCOPE STUDIES OF EARLY MORPHOLOGICAL EFFECTS OF X-RAYS ON THE INTERNAL STRUCTURE OF THE CHROMOSOME. p.82 of "Research and Development in Progress - Biology and Medicine, Issue No.4". TID-4204, Division of Biology and Medicine (AEC), Washington, D.C. Apr. 1966, 229p. Abstr. B1A 1683.

Grasshopper neuroblasts to be used, also doses of the order of several thousand R of x-rays.

997 Carlson, J.G. STUDIES OF EARLY EFFECTS OF RADIATION ON CHROMOSOMES AND MITOSIS. Progress Report, March 1, 1966-February 28, 1967. ORO-2575-32, Tennessee Univ., Knoxville. Inst. of Radiation Biology. 1967, 4p.

The effects of various wavelengths of monochromatic u.v. radiation on mitosis and the incorporation of ^{3}H-thymidine in the nucleus of grasshopper embryos in hanging drop cultures were evaluated in autoradiograms. Preliminary results suggest that at least a portion of the induced incorporation of ^{3}H-thymidine is not simply repair of directly damaged DNA. Electron microscope studies of early morphological effects of x-radiation on the internal structure of chromosomes of grasshopper neuroblasts were continued and methods of sample preparation are discussed. A preliminary study indicated that the addition of actinomycin D to the culture media blocked the uptake of ^{3}H - uridine (RNA synthesis) in neuroblasts. (NSA 21: 1967, 20 322)

998 Day, J.W., Grell, R.F. THE EFFECTS OF EXCHANGE AND STRUCTURAL HETEROZYGOSITY ON RADIATION-INDUCED NONDISJUNCTION AND LOSS. p.64 of "Biology Division Semiannual Progress Report for Period Ending January 31, 1966". ORNL-3922, Oak Ridge National Lab., Tenn. May 1966, 207p.

The effect of 4000 R of x-rays on the frequencies of X-chromosome nondisjunction and loss in the oocytes of Drosophila melanogaster females homozygous and heterozygous for Ins(1)dl(-49, B^{M1} is shown in tabulated form. The results indicate that neither structural heterozygosity nor the presence of a crossover between homologues modifies the frequencies of radiation-induced nondisjunction or loss.

999 Day, J.W., Grell, R.F. RADIATION-INDUCED DISJUNCTION AND LOSS OF CHROMOSOMES IN Drosophila melanogaster FEMALES. II. EFFECTS OF EXCHANGE AND STRUCTURAL HETEROZYGOSITY. Mutation Res. 3, 6 (1966) 503-9.

The role of exchange and structural heterozygosity in radiation induced non-disjunction and loss in the oocyte of D. melanogaster has been investigated by irradiating two types of females, one

heterozygous and the other homozygous for a multiply inverted X-chromosome. The frequencies of exchange tetrads in the oocytes of the two genotypes were estimated as ~24% for the heterozygote and ~ 90% for the homozygote. An examination of the first 7 d broods from both kinds of females irradiated with 4000 R of x-rays revealed no significant difference in X-chromosome loss or non-disjunction between the two genotypes. The average non-disjunction frequencies for the entire period were 1.57 ± 0.19% for the homozygotes and 1.74 ± 0.24% for the heterozygotes. The corresponding frequencies of loss were 5.21 ± 0.37% and 7.19 ± 0.67%. The values obtained for stage 8-14 oocytes from homozygous and heterozygous females irradiated with 500 R were 0.22 ± 0.21% and 0.33 ± 0.18%, respectively, for non-disjunction, and 2.46 ± 0.33% and 2.57 ± 0.33%, respectively, for loss. The results indicate that neither structural heterozygosity of homologue nor exchange between homologues modifies the frequencies with which they non-disjoin or are lost following irradiation of the oocytes. (Auth. summary)

1000 Dhillon, T.S., Rai, K.S. DETECTION OF RADIATION-INDUCED PARACENTRIC INVERSIONS IN Aedes aegypti. p. 8-9 of "Information Circular Radiation Techniques and their Application to Insect Pests". WP/31/7, International Atomic Energy Agency, Vienna (Austria). 1966, 49p.

1001 Fox, D.P. THE EFFECTS OF X-RAYS ON THE CHROMOSOMES OF LOCUST EMBRYOS. II. CHROMATID INTERCHANGES AND THE ORGANIZATION OF THE INTERPHASE NUCLEUS. Chromosoma 20 (1966) 173-194.

The structure and frequency of chromatid interchange types induced by x-irradiation of Schistocerca gregaria embryo cells in the late S or early G_2 stage are described. These interchange types occur with different frequencies. On the basis of the observed polarization of the chromosomes in interphase and of the observed occurrence of loops in these polarized chromosomes in embryo cells, a model is described which can account for these differences. The model has six main features. The chromosomes in the interphase nucleus are polarized and lie parallel, possibly close to the nuclear membrane. U-type exchanges are fundamentally different from X-type exchanges and U-type exchanges are more frequent than X-type. Twisting at the point of exchange, between formation in interphase and observation at C-metaphase, is rare. The chromosomes have looped regions which may take part in interchanges. Chromosome ends may be involved in interchanges due to terminal overlapping in the nucleus as the chromosome elongates during interphase. The latter two factors result in aberrations between polarized chromosomes in interphase appearing in a non-polarized position at C-metaphase. Evidence supporting this model was derived from a study of the exchange point relative to the two centromeres and two telomeres, since the mean centromere distance C, mean telomere distance T, and mean differential distance D are expected to be different for the various hypothetical modes of aberration formation. The model implies that if the mechanism of chromosomal aberration formation is by breakage and reunion, rejoining within a site cannot be at random. Thus the results are more compatible with an exchange type of mechanism for aberration formation (NSA 21:1967, 18023)

1002 Fox, D.P. THE EFFECTS OF x-RAYS ON THE CHROMOSOMES OF LOCUST EMBRYOS. III. THE CHROMATID ABERRATION TYPES. Chromosoma 20 (1967) 386-412.

Eggs of Schistocerca gregaria were cultured and irradiated. Irradiation of embryo cells during the S and G_2 stages of interphase produces the same general classes of chromatid aberration as have been seen in organisms, such as Vicia faba. The types of aberration are described qualitatively only, in this paper. In addition, however, a series of intrachange aberrations has been found which is novel. In order to account for these Revell's exchange hypothesis has been extended to include the involvement of isolocus primary lesions. The exchange-type hypothesis is preferred because it can more readily accomodate the whole spectrum of aberrations found.

1003 Fox, D.P. THE EFFECTS OF x-RAYS ON THE CHROMOSOMES OF LOCUST EMBRYOS. IV. DOSE-RESPONSE AND VARIATION IN SENSITIVITY OF THE CELL CYCLE FOR THE INDUCTION OF CHROMATID ABERRATIONS. Chromosoma 20 (1967) 413-441.

The variation in yield and the dose-response for chromatid aberration types following x-irradiation of Schistocerca gregaria embryo cells is described. Marked variations in yield are found for all aberration types during the G_2 and latter part of S stages of interphase. Only gaps appear to follow similar curves, other aberration types having unique patterns of response. The dose exponents for the various chromatid aberration types are similar to, but lower than, those reported for other organisms. Chromatid "breaks"

appear to have a dose exponent greater than 1.0 – a fact which is in conformation with the exchange hypothesis. The chromosome radiosensitivity of this organism is similar to that reported for other organisms. (Auth.)

1004 Glotov, N.V., Sushkin, A.G. THE INFLUENCE OF THE GENOTYPE ON THE FREQUENCY OF RADIATION-INDUCED ANEUPLOIDY IN THE OOGENESIS OF Drosophila melanogaster. I. RING X-CHROMOSOME. Genetika No. 8 (1967) 60-64. (In Russian)

In the opening communication of this series of studies concerning the influence of the genotype on the frequency of radiation-induced aneuploidy in the oogenesis of D. melanogaster the dose-response curves are compared for normal and X-ring strains. In the progeny of the normal (i.e. with telomeric X) yellow-strain females the spontaneous frequencies of XXY-females and XO males were 0.22% and 0.36%, respectively, while in the progeny of females of the X-ring strain (X^C, y v) the corresponding frequencies were 0.03% and 0.12% respectively. 2-d-old females were irradiated by ^{60}Co γ-rays (doses of 1, 2, 3, 4, and 5 kR) and mated immediately to Berlin wild males. The progeny of the first 3 d of egg deposition was scored. Dose-response curves for both strains studied coincided well (the control being subtracted) and were in good agreement with the results obtained by Traut [Mut. Res. 1:1964, 157]. The lower frequency of XO-males in the progeny of irradiated X^C, y v females might be due to the lower frequency of chromosome aberrations in females [Glass, Genetics 40:1955, 252 and 281)], as well as to the relatively lower sensitivity of the method used, as compared to the calculation of females: males ratio. (Auth.)

1005 Gregg, T.G., Day, J.W. NONDISJUNCTION OF THE X CHROMOSOMES IN FEMALES OF Drosophila hydei. Genetica 36 (1965/66) 172-182.

An investigation of non-disjunction in D. hydei has diclosed that spontaneous primary non-disjunction of the X-chromosomes occurs with a frequency of 1/13 000, and secondary non-disjunction with a frequency of 1/3500. These rates are much lower than the ones previously reported for D. melanogaster which are about 1/1000 for primary non-disjunction and 1/50 for secondary non-disjunction. Data are included on a population derived from matings with females exposed to 2000 R or 4000 R x-radiation. The low rate of secondary non-disjunction in hydei is attributed to the much greater genetic length of the X-chromosome and the corresponding reduction in noncrossover X's available for distributive pairing with the Y-chromosome. The low rate of primary non-disjunction is attributed to both a reduction in noncrossover X-chromosomes, and to the large heterochromatic arm of the X-chromosome which, it is suggested, makes the X-centromere a strong centromere. Thus, it is further suggested, the reduction in non-crossover chromosomes reduces the opportunity for non-homologous distributive pairing and non-disjunction of the type involving non-crossover chromosomes. Non-disjunction of the type involving crossover chromosomes then is prevented by the success of the strong centromeres in overcoming entanglements that would lead to non-disjunction in the case of ordinary or weak centromeres. (NSA 20:1966, 22653)

1006 Grell, R.F. CHROMOSOME PAIRING, CROSSING OVER AND DISJUNCTION IN Drosophila melanogaster. ORNL-P-654. Oak Ridge National Lab., Tenn. 1964, 38p.

Results are summarized from studies of the meiotic mechanism in Drosophila. (NSA 19:1965, 3809).

1007 Grell, R.F., Muñoz, E.R., Kirschbaum, W.F. RADIATION-INDUCED NON-DISJUNCTION AND LOSS OF CHROMOSOMES IN Drosophila melanogaster FEMALES. I. THE EFFECT OF CHROMOSOME SIZE. Mutation Res. 3, 6 (1966) 494-502.

Newly eclosed females carrying two extra small chromosomes of equivalent length were irradiated, one a free IV and the other a free X duplication. In the unirradiated controls the extra chromosomes segregate from one another ~99.9% of the time and show no loss. After irradiating the mothers with 4000 R of x-ray, the average non-disjunction frequency of the two small chromosomes, as measured in the first 12 daily broods, was 1.24 ± 0.07%. This value is not significantly different from the 1.19 ± 0.15% obtained for the large X-chromosomes for the same period despite a 10-fold difference in chromosome length. The result indicates that radiation-induced non-disjunction is unrelated to chromosome length. A comparison of the frequency of loss for the large and small chromosomes discloses that in the oocyte the X-chromosomes are lost about three times as often as the duplication and the IV (5.82 ± 0.20% and 1.95 ± 0.10%, respectively). There is a marked stage sensitivity in the oocyte, with the max. loss for both the large and small chromosomes occurring in the 1st or 2nd

brood and lower frequencies occurring in later broods. The results are compatible with the hypotheses that events at the centromere or adjacent regions, incident to radiation, are responsible for nondisjunction and that radiation-induced sister-chromatid dicentric formation contributes to chromosome loss. (From auth. summary)

1008 Heddle, J. A., Wolff, S. ESTIMATION OF THE REJOINING DISTANCE FOR CHROMOSOME EXCHANGES INDUCED IN Drosophila SPERM BY COMBINED DOSES OF x-RAYS AND NEUTRONS. Int. J. Radiat. Biol. 10, 3 (1966) 207-310. Also published as ORNL-P-1580, Oak Ridge National Lab., Tenn.

The yield of x-ray-induced exchanges, Y_X, is given by

$$Y_X = \frac{2\pi h^3 n_X(n_X - 1)}{3V}$$

when h is the rejoining distance, n_X the number of primary breaks induced by x-rays and V the volume of the sperm nucleus. The yield of neutron-induced exchanges, Y_N, is given by

$$Y_N = \frac{hn_N(n_N - 1)}{d}$$

when n_N is the number of primary breaks induced by the neutrons and d = dose x energy deposited in the nucleus per unit dose ÷ track average LET. The combined number of breaks, n_C, is $n_X + n_N - 2Y_N$. The procedure outlined in the paper was repeated for three different values of V since there is some variation in the reported estimates of the dimensions of the Drosophila sperm nucleus, assumed to be cylindrical. The value of 0.1 μ obtained for h is remarkably close to the values obtained previously for Vicia faba and Hordeum vulgare. In these calculations, a dose square relation was assumed for x-ray-induced and a linear relation for neutron-induced exchanges. The combined yield would therefore really equal the observed yield at somewhat lower values of h, with a slightly overestimated value reported here.

1009 Hinton, C. W., Whittinghill, M. THE DISTRIBUTION OF x-RAY INDUCED CROSSOVERS FROM CURLY INVERSION HETEROZYGOTES OF Drosophila melanogaster FEMALES. Proc. natn. Acad. Sci. U.S.A. 36 (1950) 552-558.

The induced cross-over offspring from testcrossed S Pfd/Cy lt^3 L^4 females x-rayed with 2250 R as adults were so distributed that their meiotic origin is unlikely. The effects of the x-rays were evident for as long as 31 d, with a peak in recombination between 4 and 8 d after treatment. Wide variations from female to female were observed in total % recombination, in the relative numbers of recombinants from adjacent regions, and in the distribution of complementary cross-over classes within each region. Some tendency toward clustering of the recombinants among the testcross offspring was revealed. These results are indicative of some oogonial influence upon recombinants. This influence may be merely a weakening of oogonial chromosomes followed much later by meiotic crossing over at the weak point, or it may be completion of crossing over in the oogonia. The data on the variable balance of complementary classes favours the latter hypothesis. (Auth. summary)

1010 Ives, P. T. GENETIC AND DIRECT EFFECTS OF GAMMA RADIATION ON Drosophila. NYO-2467-17, Amherst Coll., Mass. Dept. of Biology. 20 Sep. 1966. 5p.

Additional data were procured to help elucidate the pattern of mutagenesis displayed in successive stages of spermatogenesis following acute doses of radiation. Under controlled conditions the peak rate of induced translocations in males raised at 18°C, which doubles the length of time needed to complete development compared to 25°C, hits a peak in the 10-20 d sample of sperm instead of in days 5 and 6 characterizing 25°C-males. Thus the production of chromosomal aberrations shows the same change in pattern as does the production of point mutations when developmental temperature is lowered to 18°C. The rate of mutational effect thus appears to depend on the stage of spermatogenesis at which radiation enters the gonads. Additional data were obtained from pattern analysis of the comparative mutagenic rates in mature sperm, those deposited in the 1st mating after irradiation and in those sperm deposited in subsequent matings during the first day after irradiation ("premature sperm"). At doses of 1 kR γ-rays or hard x-rays point mutations are induced at equal

frequencies in the two types of sperm, whereas chromosome rearrangements (autosomal and Y-chromosome translocations) are produced at nearly twice the frequency in mature sperm.

1011 Kale, P.G. INDUCED CROSSING-OVER IN THE MALES OF Drosophila ananassae: EXCHANGES MAINLY IN SPERMATOCYTES OF ADULTS. Mutation Res. 4, 5 (1967) 631-639.

Crossing-over in males of D. ananassae was studied by treating young and 48-h-old adults with 1000 R and 2000 R of x-rays. Among the 76 irradiated males only three showed exchanges in their gonial cells, while the others produced crossovers in the period of partial sterility. The individual variation in crossover production of these males can be fitted to a Poisson distribution and the complementary recombinants from the individual males show no significant departures for equality. These crossovers therefore appear to have originated in treated spermatocytes. Continued appearance of only one complementary recombinant class in two males gives evidence in favour of cambial-like divisions of the primary spermatogonia. A proportional increase of recombination frequency with radiation dose, after exposure of adults, suggests a one-hit nature of induced crossing-over. (Auth.)

1012 Kale, P.G., CROSSING-OVER IN THE MALES OF Drosophila ananassae: EXCHANGES IN IRRADIATED PUPAE. Int. J. Radiat. Biol. 13, 1 (1967) 1-12.

Crossing-over in the males of D. ananassae has been studied by treating early and mid-pupal stages with 1000 R and 2000 R of x-rays. Spermatocytes produce single cross-overs distributed evenly between males. Spermatogonia produce clusters of cross-overs, the progeny of particular males. A 2-fold increase in the frequency of cross-overs from independent events by doubling the dose indicated the breakage of two chromatids by a single ionizing particle. The frequency of these exchanges in early pupae is much greater than of those in later stages of the life-cycle. This has been attributed to the predominant proportion of the spermatocytes in the young pupae. Alternatively these early spermatocytes may be intrinsically more sensitive. (Auth.)

1013 Kang, Y.S., Lee, C.C. THE GENETIC STUDIES OF Drosophila POPULATION. 2. ON THE FREQUENCIES OF RECIPROCAL TRANSLOCATION IN D. melanogaster IRRADIATED WITH x-RAYS. Korean J. Zool. 8, 2 (1965) 9-14. (In Korean, with English summary)

The frequency of reciprocal translocation damage in males of D. melanogaster irradiated with x-rays was observed in this study. The frequencies were checked at four periods with 2-d intervals and during spermatogenesis after irradiation. (1) Modifications in the percentage of the reciprocal translocation damage were not obtained at intervals after irradiated with 500 R and 1500 R of x-rays respectively. (2) In two experimental groups irradiated with 500 R and 1500 R of x-rays, the frequencies showing in the spermatogenesis were 0.50% (500 R), 3.85% (1500 R) in mature sperm, and 1.59%, 8.10% in the spermatocyte. (3) The frequency of reciprocal translocation between the Y- and 3rd chromosomes was the highest, but in accordance with dosage increase that of the 2nd and 3rd chromosomes relatively increased from 9.34% - 30.49% while decreased from 68.75% - 46.80% in the group of the Y- and 3rd chromosomes. (4) It was supposed that these modifications of the frequency were due to heavy damage of the 2nd chromosomes than other chromosomes in accordance with dosage increase. (5) Spontaneous reciprocal translocations involving the Y-, 2nd and 3rd chromosomes was 0.23%. (Auth.)

1014 Kang, Y.S., Lee, C.C. THE FREQUENCY OF RECIPROCAL TRANSLOCATION IN D. melanogaster IRRADIATED WITH 500 OF x-RAYS. Drosoph. Inf. Serv. 41 (1966) 114-115.

D. melanogaster (Seoul strain) males and vg;se mutant females were used. Data on the frequency of reciprocal translocations in the control group, at intervals and during spermatogenesis after irradiation, and data from a comparison of the translocation frequency among Y-, 2nd and 3rd chromosomes in control and irradiated group are tabulated. The mean frequency of reciprocal translocations appearing in the control group was 0.256% in the Seoul strain. At the three intervals tested, no significant difference in frequency was observed. The frequency of reciprocal translocations during spermatogenesis was 0.503% on days 1-2, 1.594% on days 5-6, involving a factor of 3. The comparison of the translocation frequency among Y-, 2nd and 3rd chromosomes indicated that the Y- and 3rd chromosomes were involved most frequently.

1015 Karlson, P. ZUR CHEMIE UND WIRKUNGSWEISE DER INSEKTENHORMONE. (The chemistry and mode of action of insect hormones.) p.37-47 of "Proceedings of the 4th International Congress of Biochemistry. Vienna, 1-6 Sep. 1958". Vol.12. Levenbook, L., Ed. London, Pergamon Press. 1959, 252p. (In German)

Review article. The insect hormones known to date are discussed: (1) the brain (prothoracotropic) hormone; (2) the prothoracic gland hormone (ecdysone); (3) juvenile hormone. Another hormone, the diapause factor, is produced by the suboesophageal ganglion, and controls diapause in Bombyx embryos and perhaps also other types of diapause in other species. - Ecdysone had proved active in all insects tested so far, and also seems to be active in Crustacea, and Crustacean extracts appear active in insects. The interchangeability also holds for some other hormones. The mode of action of ecdysone and the biochemical basis of Calliphora assays were studied by the author. In experiments with radioactive tyrosine and dopa these compounds were shown to be precursors of the presumed quinones, which are largely incorporated into the cuticle. The process occurred 20-24 h after injection of the hormone; without ecdysone, no radioactivity was incorporated into the cuticle. During the last days of larval life, tyrosinase activity changes considerably. Tyrosinase is present in the larva in an inactive form; homogenates develop activity within 15-20 min. The author believes that the hormone acts on the activating system and induces production of active tyrosinase, which in turn produces the quinones to be subsequently incorporated into the cuticle.

1016 Leach, W.M., Carlson, J.G. EARLY CHROMOSOMAL RESPONSE TO x-RAYS. (Read by title only) J. Cell Biol. 31, 2 (1966) 149A. Abstr. 299, at "6th Annual Meeting of the American Society for Cell Biology, Houston, Texas, USA. 17-19 Nov. 1966".

Grasshopper neuroblasts which are in late prophase, very late prophase, or prometaphase during exposure to x-rays may contain "sticky" chromosomes during the subsequent mid-mitotic period (metaphase and anaphase). Three types of "stickiness" may be distinguished: (1) clumping, separate chromosomes appearing fused, usually near their distal ends; (2) adhesion, sister chromatids appearing fused to each other; and (3) beading, the chromosome outline appearing moniliform. Embryos of Chortophaga viridifasciata (De Geer) were exposed to 1024 R of x-rays at a rate of about 220 R/min. The target-to-specimen distance was either 30 or 60 cm. Amperage was adjusted so that the exposure rate was essentially constant for both distances. Embryos were fixed 15 min after x-ray exposure, and acetocarmine squashes were prepared. At the 30-cm distance 291 mid-mitotic neuroblasts were observed, 52% with chromosome clumping, 59% with chromatid adhesions, and 12% with chromosome beading. At the 60-cm distance 130 mid-mitotic neuroblasts were observed, 24% with clumping, 32% with adhesions, and 10% with beading. Placement of 12 mm of Lucite above the embryos during exposure substantially reduced the yield of clumping, but not of adhesions or beading, at the 30-cm distance: of 143 mid-mitotic neuroblasts observed, 32% showed clumping, 53% showed adhesions, and 10% showed beading. The ratios between the mid-mitotic stages observed were about the same from embryo to embryo. The differences in frequencies of types of "stickiness", then, were not a result of differences in composition of cell populations, but rather the result of different conditions of x-ray exposure. (Abstr.)

1017 Leach, W.M. LACK OF x-RAY INDUCED CHROMOSOME "STICKINESS" IN GRASSHOPPER NEUROBLASTS. Radiat. Res. 31, 3 (1967) 575-576. Abstr. Cc-12 at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Embryos of the grasshoppers Chortophaga viridifasciata (De Geer) and Encoptopholus sordidus (Burmmeister) were exposed to 1000 R of x-rays (250 kV >, 15 MA, from a Westinghouse "Coronado" machine with inherent filtration equivalent to a half-value layer of 0.4 mm Cu, no added filtration, target-to-specimen distance 50 cm, exposure rate about 168 R/min). At 15 or 30 min after the beginning of exposure, embryos were fixed with 1 : 3 acetic ethanol, then stained with aceto-orcein and squashed. About 60% of Chortophaga neuroblasts in midmitosis (prometaphase, metaphase, and anaphase) contained "sticky" chromosomes. However, only an occasional midmitotic Encoptopholus neuroblast had "sticky" chromosomes. Similar results were obtained for the Encoptopholus neuroblasts, whether the embryos were exposed intact in eggs or dissected in a glutamic acid-glycine culture medium. The virtual lack of "sticky" chromosomes in the Encoptopholus neuroblasts suggests that x-ray-induced "stickiness" may result from an early action of chromosomal material other than deoxyribonucleic acid. (Abstr.)

1018 Lucchesi, J.C. THE EFFECT OF HETEROZYGOUS AUTOSOMAL INVERSIONS ON INDUCED EXCHANGES BETWEEN THE ATTACHED-X AND Y CHROMOSOMES IN Drosophila melanogaster FEMALES. Genetics 54, 4 (1966) 1013-1018.

The presence of an inverted major autosome increases the frequency with which x-ray* induced exchanges between the attached X- and Y-chromosomes are recovered. This increase, magnified when both autosomes are structurally heterozygous, is manifested in three 3-d progeny broods but is increasingly marked in successive broods. These experimental results are considered in terms of possible physiological and mechanical explanations. (Auth. summary)

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* 3000 R.

1019 Mainx, F., Doschek, E. GENETIC CROSSING OVER IN BOTH SEXES OF Megaselia scalaris. Mol. Gen. Genet. 99 (1967) 203-218. (In German)

Recombination in Megaselia males as compared to females is variably reduced. The magnitude of the reduction of crossing-over values within the different chromosomes and within the different zones of chromosomes depends on the site of the sex-realizer. Crossing-over in females is of the common meiotic type. Crossing-over in males is probably premeiotic, spermatogonial. Double crossing-over between the sex-realizer and the next marker and between this and the 2nd marker shows always a high negative interference. Low temperature and x-irradiation enhance the crossing-over values in females and in males. Low temperature enlarges the interference, x-irradiation reduces the interference of double crossing-over in the female. (Auth.)

1020 Makino, S., Nakanishi, Y.H. BEHAVIOR OF THE CHROMOSOMES IN GRASSHOPPER, Podisma sapporense GERM-CELLS IN RESPONSE TO LOCALIZED BETA-IRRADIATION. (BAg 30: 1966, 21897) Nippon Saibo Kagakkai Shinpojuma 14, Suppl. (1964) 355-359.

1021 Malich, C.W., Binnard, R.M. CHROMOSOME BREAKAGE AND LOSS FOLLOWING ALPHA PARTICLE TREATMENT OF Drosophila. Radiat. Res. 27 (1966) 493. Abstr. Bb-2, at "14th Annual Meeting of the Radiation Research Society, Coronado, Calif., USA. 13-16 Feb. 1966".

Alpha particles with LET 200 MeV/gm/cm^2 produce unhealed breaks in the chromosomes of mature sperm of D. melanogaster about as frequently as equal doses of 300 kVp x-rays, even though the induction of autosomal translocations is one-hit for alphas and two-hit for x-rays. The use of a marked Y-chromosome, $y^+ \cdot Y \cdot B^S$, discloses partial losses of 0.2% per krad and losses of the whole Y (or X) of 0.3% per krad, while sex-linked recessive lethals occur at a rate of 3% per krad. Further studies show that both alphas and x-rays produce the same proportion of mosaics: 14% of the partial losses and 2% of the whole losses. In addition, crisscross mosaics occur as frequently as regular mosaics involving both traits. Although all classes of mosaics can be explained by mitotic loss of the whole Y with appropriate (sometimes irregular) cell lineages during embryonic development, limited progeny tests indicate that most of the mosaics represent fractionals. Breeding the treated males to females having both arms of a Y attached to their X-chromosomes increases the fertility of whole losses from 3% - 94% and will permit cytogenetical investigations as well as more comprehensive progeny tests. Apparent loss of the whole Y (or X) has nearly doubled with this stock (for both alphas and x-rays), suggesting the possibility of some selective loss with standard stock. From these diverse observations of breakage events in different regions of the sperm head, we conclude that the radial spread rather than the density of ionization along an α-particle track is responsible for the one-hit kinetics of the translocations, and that this spread of ionization is effective over several tenths of a micron but probably not as far as a few microns. (Abstr.)

1022 Novitski, E., Myszewski, M.E., Goldin, H. DICENTRIC CHROMOSOMES IN Drosophila. Drosoph. Inf. Serv. 42 (1967) 105.

Females heterozygous for a long inversion provide the system where dicentric chromosomes are formed with regular frequency: Irradiation of these females would introduce random damage to the centromere regions of these crossover-produced dicentrics. In the instance where one of the centromeres is altered in the manner described previously, the 2nd centromere could act to carry the new chromosome to the pole. This would provide a class of progeny generally lost and would also provide chromosomes with particularly interesting properties. Should dicentric chromosomes such as these be recovered, their analysis may provide useful information concerning centromere strength,

activity of heterochromatin and chromosome structure. A simple experiment was designed to generate dicentric chromosomes. 4-d-old females were x-rayed with 2700 R and mated immediately to X/Y males carrying a yellow mutant. Among 37 370 progeny from irradiated females, 324 flies carrying $\underline{y}^{+}\underline{B}^{S}$ and intermediate markers indicative of single crossing over were observed. No flies of the $\underline{y}^{+}\underline{B}^{S}$ phenotype appeared among 16 626 progeny from nonirradiated females. Of the original 324 exceptional $\underline{y}^{+}\underline{B}^{S}$ flies, 186 (62 males, 124 females) proved to be fertile. These fertile exceptions are currently being tested to ascertain whether the $\underline{y}^{+}\underline{B}^{S}$ markers are actually carried by a dicentric chromosome or if they merely represent a tantalizing rearrangement of the markers. (From DIS)

1023 Oak Ridge National Lab., Tenn. Drosophila CYTOLOGY AND GENETICS. p. 59-64 of "Biology Division Semiannual Progress Report for Period Ending January 31, 1966". ORNL-3922. May 1966, 207p.

Research progress in Drosophila cytology and genetics is reported on: a tandem duplication that lowers recombination throughout a chromosome arm; translocations as crossover suppressors; the frequency of x-radioinduced crossover-suppressing aberrations recovered from oocytes; scintillation counting of ^{3}H-thymidine transferred to females by labelled males; a mutation induced by ethyl methanesulfonate that alters electrophoretic mobility of alcohol dehydrogenase isoenzymes; the meiotic origin of temperature-induced crossing-over; and the effects of exchange and structural zygosity on radioinduced non-disjunction and loss. (NSA 20: 1966, 40625)

1024 Ogaki, M., Nakashima-Tanaka, E. INHERITANCE OF RADIORESISTANCE IN Drosophila. Mutation Res. 3 (1966) 438-443.

Two wild-type strains of Drosophila melanogaster, Hikone-H and Mino-H, are radioresistant to γ-rays, but a Yamaguchi wild-type strain is radiosensitive, as are also two mutant strains, bw;st ss and vg-ms;se. In general, the females from these strains are more resistant than the males. Reciprocal crosses showed that resistance to radiation is dominant to sensitivity, and that maternal or cytoplasmic effects are negligible. The III-chromosome is mainly responsible for radioresistance in these strains, and the locus of the principal gene(s) for radioresistance may be near the right end. (Auth.)

1025 Olivieri, G., Olivieri, A. EVIDENCE FOR THE TWO-HIT NATURE OF x-RAY INDUCED CROSSING-OVER IN THE CENTROMERIC REGION OF Drosophila MALES. Mutation Res. 1 (1964) 279-295.

In order to study the relationship between dosage and frequency of x-ray-induced crossing-over in males of D. melanogaster, four samples of about 130 males each were irradiated with doses of 500, 1000, 2500, and 4000 R respectively. On the 10th to 11th day after irradiation, the two classes of complementary crossovers were found to occur independently of each other in the progeny of the individual males, and the distribution of crossovers per irradiated male followed a Poisson distribution. In consequence, the clusters in this brood were considered as pseudo-clusters, originating from different crossover events in the latest gonial cells. It is this stage that is characterized by the highest sensitivity to the induction of crossing-over. The number of crossovers found on these days has therefore been used as a direct estimate of the number of crossing-overs produced, taking into account the probable induction of crossing-over at the fourstrand stage. After logarithmic transformation, a linear relationship was observed between the dose and the percentage of crossovers produced in the late gonial cells in the centromeric region of the IInd chromosome (regression coefficient = 1.768 ± 0.030). Crossing-over induced in this chromosome region therefore is most probably a two-hit phenomenon, to be explained in terms of two distinct and independent breaks. This conclusion is further supported by the observation that fractionation of the dose significantly reduced the frequency of induced crossing-over. When N_2 was given between the fractions the crossing-over frequency was restored to that of unfractionated radiation. It is thought that N_2 acts by preventing restitution of the breaks required for the pseudo-crossing-over. Post-treatment with N_2 after unfractionated radiation resulted in a significant enhancement of the crossing-over frequency. Irradiation in N_2 reduced the frequency of induced crossing-over to about 1/5 of that observed in air, whereas radiation exposure in oxygen approximately doubled the crossing-over frequency as compared to that induced in air. The radiosensitivity in O_2 and N_2 differed by a factor of about ten. This is considered to offer further support for the two-hit origin of induced centromeric crossing-over in this stage. (Auth.)

1026 Reddi, O.S. INTERACTION OF x-RAY AND FAST NEUTRON-INDUCED CHROMOSOME BREAKS IN Drosophila. p.185 of "3rd International Congress of Radiation Research. Cortina d' Ampezzo, Italy. 26 Jun.-2 Jul. 1966, 263p". Abstr. 733.

Lack of interaction of x-ray- and neutron-induced chromosome breaks was noticed in Vicia and Tradescantia as expected on the basis of linear neutron kinetics for two break aberrations. However, interaction was observed between x-ray and chemically induced breaks in Drosophila. Experiments were undertaken 1) to evaluate the interaction of x-ray-and neutron-induced breaks;2) to check the dose linearity with fast neutrons;and 3) to detect any dose-fractionation effect. Adult males of D. melanogaster were exposed to x-rays (3000 R; 150 kV at a rate of 200 R/min) or varying doses of fast neutrons (400, 800 and 1600 rad) of 12-14 MeV energy spectrum from a Cascade generator or both. After irradiation each male was mated with three virgin females of a dual purpose stock, y sc^{S1} In-49 sc^{S}; bw; st. After 3 d all the males were discarded and the fertilized females were transferred to bottles heavily seeded with yeast. The F_1 males were used to screen the translocations and the F_1 females were utilised to detect the incidence of sex-linked recessive lethals. The results are presented below:

Interaction data

Type	Dose	SLRL	Trans
x-rays	3000 R	(480) 5.00	(510) 4.11
Fast neutrons	800 rad	(720) 3.75	(700) 5.00
x-rays followed by neutrons	.....	(600) 9.66	(520) 11.92
Neutrons followed by x-rays	.....	(591) 9.98	(558) 10.93

The results indicate that the yield of combined treatment is more than additive. Dose linearity with neutrons was also checked and the results are shown below:

Dose in rad	SLRL	Trans
400	(800) 2.5	(840) 2.14
800	(720) 3.75	(700) 5.00
1600	(500) 7.6	(552) 10.68

The results were discussed. (From abstr.)

1027 Rinehart, R.R. IDENTIFICATION OF THE PROPOSAL: x-RAY INDUCED CHANGES IN Drosophila GERM CELLS. Progress Report, September 1, 1965-August 31, 1966. SAN-590-1, San Diego State Coll., Calif. 18p.

A further series of tests concerning the mutability of irradiated food and food components has been completed. Irradiated DNA added to Drosophila media has no modifying effect on sex-linked recessive lethality. Tests with irradiated sucrose as a food supplement are nearing completion. Dr. Frank Ratty is concerned with this aspect of the work. Measurements of frequencies of detachment of attached-X chromosomes as well as detachment partner from females given extended helium treatments have supported previous similar tests in which dominant lethality was the parameter of x-ray damage. In addition, these tests have indicated a random association of chromosomes in stage 7 oocytes while some polarization of pairing exists in stage 14 oocytes. When irradiated single females were extensively brooded so that a large sample of eggs were available from one female, it was observed that there were multiple detachments in many females, more than could be expected from randomness alone. If a detachment occurred in an egg from one female , many more detachments would be found in subsequent eggs, and they were of a similar kind. A decrease in sex-linked recessive lethality and a concomitant increase in dominant lethality in stage 7 oocytes from females given extended helium treatments has been observed. Experiments to test the modifying effects of extended helium

treatments on the recovery of different male spermatogenic stages as well as sex-linked recessive lethal, dominant lethal, II-III translocation and non-disjunction frequencies were performed. Work in progress is discussed, including clarification of possible repair of premutational events.

1028 Roberts, P. SPONTANEOUS AND x-RAY INDUCED EXCHANGE IN Drosophila melanogaster. Genetics 50, 2 (1964) 280. Abstr., at "15th Annual Meeting of the American Institute of Biological Sciences. Boulder, Colo., USA, 23-28 Aug. 1964".

See III/576: original published without abstract.

Females homozygous for In(1)sc^{8} or the normal X-chromosome but heterozygous for recessive markers were exposed to 4000 R and recombination was measured in 12-d brood fractions. Induced exchange in the heterochromatin that is moved distally by In(1)sc^{8} was greater than that observed in the heterochromatin in its normal proximal position. If successful recombination is dependent on proximity of broken ends at the time of irradiation, the heterochromatic regions of homologues are probably more closely associated in early oocytes at the time of crossing-over and in oogonia than in late oocytes. The increase in both spontaneous and x-ray induced exchange in proximal regions which have been moved distally suggests that effective pairing of homologues is normally lowered in centromeric regions, perhaps as a compensation for heterochromatic associations there. A comparison of x-ray induced exchange in the normal and inverted chromosomes with and without the crossover suppressor c3G indicates that most of the heterochromatic increase after Day 8 can be attributed to exchanges induced in oogonial chromosomes at the time of irradiation. The proximaleuchromatic increase and the euchromatic decrease apparently result from radiation effects which persist through at least one cell division and alter the behaviour of chromosomes during meiosis. - Unequal crossing-over in the Bar tandem duplication (B-57.0) was measured with and without a closely linked tandem duplication which also undergoes unequal crossing-over, Bx^{r}49^{k} (Bx-59.4). A slight increase in B reversions in the presence of Bx^{r}49^{k} is proportionate to an increase in regular crossovers in this region caused by addition of the duplication. Failure of the Bx duplication to increase asymmetrical pairing of B suggests that pairing in Drosophila oocytes is discontinuous and that the effective pairing segment is less than 2.4 map units in length. (Abstr.)

1029 Scriba, M.E.L. BEEINFLUSSUNG DER FRÜHEN EMBRYONALENTWICKLUNG VON Drosophila melanogaster DURCH CHROMOSOMENABERRATIONEN. (Influence of chromosomal aberrations on early embryo development in Drosophila melanogaster.) Zool. Jb., Anat. Ontol. Tiere 81, 3 (1964) 435-490. (In German)

The cleavage period of the egg was studied by paying special attention to chromosome aberrations which lead to dominant lethals. The normal development of the embryo, up to 6 h, is described. Unfertilized eggs give an indication of the contribution made by the egg cytoplasm. Such an egg is able to maintain its normal structure and function for 3-4 h. Irradiation of sperm with 15 000 R of x-rays induces chromosome aberrations. Cleavage nuclei of eggs fertilized by irradiated sperm reach the 32-nuclei stage, at best. Arrested cleavage is due to disturbances in the spindle, and not to the effect of dominant lethals. The egg structure remains normal beyond the moment of cleavage inhibition. The loss of the X-chromosome in the zygote nucleus from an attached-X-crossing does not affect cleavage. The nullo-X-eggs show lethal characteristics only at the stage of blastoderm formation. They have two Y-chromosomes in their nuclei, in addition to the diploid autosome set. The nullo-X-gamete is capable of developing the posterior midgut. The proctodeum remains uninverted. Following the loss of the X- and Y-chromosomes a zygote nucleus is formed, which possesses only a diploid autosome set. The sites of nucleolus formation are lost together with the sex chromosomes. Nullo-XY-eggs pass through the cleavage stage in the normal way. The pattern of damage largely follows that of the nullo-X-eggs. Merely the formation of the generative cells, the pole cells, appears to be more markedly disturbed in the nullo-XY-gametes. Presumably there is some relation between the incompletely organized pole cells and the absence of the basal structure for the posterior midgut. There is no indication of growth around the posterior pole towards the dorsal side of the egg. The proctodeum does not get formed. The developmental processes in the early embryo involving lethal factors show a certain independence of the loss of genetic material during the cleavage period. Cleavage of the Drosophila egg appears to be more subject to cytoplasmic influence.

1030 Sinkha, S.P. COMPARATIVE STUDY OF CROSSING-OVER IN TWO LINES OF Drosophila melanogaster. p. 201-208 of "Vliyanie Ionizirovannykh Izluchenii na Nasledstvennost". Dubinin, N.P., Ed. Moscow, Izdatel'stvo Nauka. 1966. (In Russian)

Heterozygotic females of two lines of D. melanogaster, Magarach and D-18, 0-24 h old were kept at 37°C for 8 h. A high rate of crossing-over was found in the offspring on the 6th to 7th day. After irradiation with 2000 R of x-rays, flies exhibited the same increase on the 6th to 7th days and it was also found to the 11th day in Magarach and the 14th day in D-18. Comparative study of the induced crossing-over showed the former is radioresistant and the latter radiosensitive. After irradiation with 2000 R it was found that higher temperatures increased the frequency of induced crossing-over in Magarach but not in D-18, and that the increase occurred in D-18 with a dose of 1000 R. (NSA 22: 1968, 21484)

1031 Sperlich, D. EQUILIBRIA FOR INVERSIONS INDUCED BY x-RAYS IN ISOGENIC STRAINS OF Drosophila pseudoobscura. Genetics 53 (1966) 835-842.

Strains made isogenic for their IInd and IIIrd chromosomes were irradiated. Males were exposed either to three x-ray doses of 3000 R with intervals of 3 d between the exposures, or to two doses of 4500 R with the same interval, at 2183 R/min. Nine inversions (one of them double) were induced in chromosome III and four in chromosome II. Experimental populations were made carrying the induced inversions, with initial gametic frequencies of 25%. In six of the populations the induced inversions were eliminated, or were close to elimination, within a year; three populations were lost by contamination (including one with inversions both in the IInd and in the IIIrd chromosomes); and in two remaining populations the inversions established balanced equilibria. These two heterotic inversions are the more remarkable since they are lethal, or at least semilethal, in homokaryotypes. Induced heterotic mutants, as well as heterotic position effect, could explain these heterotic inversions.

1032 Srivastava, M.D.L., Bachher, K.S. EFFECT OF x-RAYS ON THE CHROMOSOMES OF Chrotogonus incertus Bolivar (ACRIDIDAE). Caryologia 19 (1966) 513-521.

Specimens of C. incertus were exposed to 400, 500, and 800 R and spermatocytes were examined 24 h subsequent to exposure. Exposure to 800 R caused aggregation of chromosomes into large vacuolated masses, which were unequally divided between the secondary spermatocytes. Another effect was extreme fragmentation of chromosomes. Exposure to 400 and 500 R caused comparatively moderate aberrations—lagging and incomplete breaks. (Auth.)

1033 Strangio, V.A. BROOD SENSITIVITY PATTERNS AFTER THE IRRADIATION OF MALES BEARING A ROD, RING OR INVERTED-X AND A DOUBLY MARKED Y-CHROMOSOME. Drosoph. Inf. Serv. 41 (1966) 176.

Males bearing either a rod (R), ring (X^{C2}) or inverted (M5) X-chromosme and a doubly marked Y-chromosome ($B^s Y \underline{y}^+$) were irradiated with 800 R x-rays. Partial or complete sex chromosome loss, induced X-$\bar{Y}$ exchange and/or non-disjunction were recorded. A table is given showing the daily brood sensitivity patterns for some of these aberrations. In general, the sex chromosome loss patterns are comparable except for the markedly increased amplitude found in the ring-X series as expected and as previously noted by Sobels (1963). An unexpectedly high recovery of yellow-Bar females, i.e. recombinant X's from induced exchange between the inverted-X (a Barless Muller-5 chromosome) and $B^s Y \underline{y}^+$ during a study of spermatogenic sensitivity to the induction of sub-terminal deletions (Lüning 1954) led to a re-appraisal of supposed non-disjunctional exceptionals from rod-X experiments (Strangio 1961), confirming studies independently undertaken by Zimmering and Wu (1964). Induced X-Y exchange is predominant over non-disjunction in both rod and inverted-X experiments. This is not immediately apparent in the results given for the inverted-X which have not been adjusted here for a relatively inflated spontaneous rate of primary non-disjunction. However, the position is definitely reversed for the ring X. The dicentric configuration produced after exchange between the ring X and Y probably accounts for this situation. However, a rare rupture of this dicentric in a heterochromatic region may sometimes be followed by healing and the recovery of a monocentric recombinant X. (From auth.)

1034 Thomas, R.E., Roberts, P.A. COMPARATIVE FREQUENCY OF x-RAY INDUCED CROSSOVER-SUPPRESSING ABERRATIONS RECOVERED FROM OOCYTES AND SPERM OF Drosophila melanogaster. Genetics 53 (1966) 855-862.

One thousand chromosome arms from x-irradiated oocytes of D. melanogaster (stage 7 and earlier) were screened for crossover-suppressing aberrations; two such aberrations were recovered, but neither was an inversion. The yield of intrachromosomal rearrangements recovered from oocytes was an order of magnitude below that recovered from sperm given the same radiation exposure. Possible explanations for the differences in aberration yield from the two germ-cell stages and their relation to the problem of dominant lethality in oocytes are considered. (Auth.)

1035 Thomas, R.E., Roberts, P.A. COMPARATIVE FREQUENCY OF x-RAY-INDUCED CROSSOVER-SUPPRESSING ABERRATIONS RECOVERED FROM OOCYTES AND SPERM OF Drosophila melanogaster. p. 60 of "Biology Division Semiannual Progress Report for Period Ending January 31, 1966". ORNL-3922, Oak Ridge National Lab., Tenn. May 1966, 207p.

For abstract, see 1034.

1036 Thompson, P.E., Yamazaki, T. TRANSLATION AND NONHOMOLOGOUS ACTIVITY OF SEGREGATION-DISTORTER (SD) IN MALES OF Drosophila. Genetics 56, 3 Pt.2 (1967) 592-593. Paper presented at the "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA 31 Aug.-2 Sep. 1967".

Modifiers of the activity of Segregation-distorter (SD) have been induced by irradiation of males with high activity. Several modified lines can be shown to have rearrangements in chromosome II, carrying SD itself. To some extent, the reduction in SD activity seems related to the positions of breaks in chromosome II, although many of the induced modifiers are in non-homologous chromosomes. Distant breaks in 2 R have much less effect on segregation-distortion in males than on female crossing over in the same region. – In the case of two among nine reciprocal translocations of Y and 2, where SD is included in the translocation, heterozygous males produced a remarkably high frequency of exceptional X0 sons having the SD+ homologue and no translocation elements. The reciprocal class of exception XX, T(Y;2) females is negligible in number. Because the exceptional X0 class is virtually absent when the SD-bearing translocations are paired with an insensitive homologue, its occurrence clearly depends on segregation-distortion and not on the rearrangement or on the mechanics of pairing alone. – Although the two translocations distort strongly against their SD+ cn bw homologue, and this activity has been shown to depend on the genic composition of chromosome II, their net effect against recovery of the X-chromosome is even greater. Curiously, this larger non-homologous effect depends on the exceptional male class in which SD itself is lost. In these cases, the elimination of the X-chromosome cannot involve pairing of the kind which determines segregation. (Abstr.)

1037 Tikhomirova, M.M. MECHANISM OF x-RAY INDUCTION OF ANEUPLOID GAMETES. Genetika No.4 (1965) 63-68. (In Russian)

Studies with Drosophila showed that intensity modified the effects of x-irradiation within the same dose range. Data are given also that attribute radioinduced non-disjunction in Drosophila chromosomes to chromosome breakage and reunion. (NSA 20: 1966, 24892)

1038 Tikhomirova, M.M., Dzhimelin, A.A., Belyatskaya, O.Ya. GENETICAL AFTER-EFFECTS OF x-RAYS DEPENDING ON THE TEMPERATURE REGIME. Genetika No. 5 (1967) 95-104. (In Russian)

It was shown by the study of the dependence of the aftereffect of x-rays on the regime of the subsequent high temperature treatment on chromosomes of Drosophila melanogaster that the aftereffect is proportional to the duration of exposure to high temperature within the interval between 30 min and 8 h and 30 min after irradiation; each hour of exposure to high-temperature resulted in the actual occurrence of 0.24% of potential breaks. Without temperature treatment, however, the kinetics of repair of hard x-ray-induced potential damages had an uneven character: most of them were repaired during the first 30 minutes after irradiation, but subsequently the rate of reparation slowed down. In case of soft x-rays the aftereffect (120%) could be detected only when the temperature treatment was immediate, which suggests that all the potential breaks are repaired during an hour after irradiation without any subsequent temperature treatment. By the comparison of the effects of hard and soft x-rays it was shown that they are equally effective so far as the total frequency of breaks is concerned. Both kinds of x-rays differed only in the relative proportion of the types of breaks: hard x-rays induced somewhat more potential breaks and less actual breaks as compared to soft x-rays. (Auth.)

1039 Tokunaga, C., Arnheim, N., Jr. AGE DEPENDENCE OF LOCATIONS OF x-RAY-INDUCED SOMATIC CROSSING-OVER IN Drosophila. Genetics 54 (1966) 267-276.

Radioinduced somatic crossing-over was studied in the left arm of the IInd-chromosome in D. melanogaster. In experiments with the genes Tufted (Tft, 48.5 – 54.5) or Bristle (Bl, 54.8), x-irradiation given early in development resulted in more somatic exchanges to the left of these loci than to the right of them. Later in development the opposite was true, with more crossing-over occurring to the right than to the left. It would appear that both the Bl and Tft loci lie between two chromosome regions which differ in the time during ontogeny at which they are maximally sensitive to x-ray induced somatic crossing-over. (Auth.)

1040 Traut, H. x-RAY INDUCTION OF AUTOSOMAL TRANSLOCATION IN MATURE OOCYTES OF Drosophila melanogaster. Nature, Lond. 214 (1967) 718-719.

The rather low dose of 500 R of x-rays was shown to induce a relatively high frequency of autosomal translocations in mature oocytes. The difference between the irradiated (12/2653) and the control series (0/3283) is highly significant ($P = 0.001$, calculated by the χ^2-method with Yates' s correction for continuity). The same dose (500 R), applied under similar physical conditions, induces a II-III-translocation frequency of 0.55% in mature sperm (see II/979). This sperm value can be directly compared with the oocyte value of 0.45%, because the corrections for the diploid nature of oocytes as compared with the haploidy of sperm and the loss of symmetrical translocations by meiotic segregation at least roughly compensate each other. A comparison with the stage 7 experiments shows that in stage 14 oocytes about 100 times as many autosomal translocations are induced by 500 R as in stage 7 oocytes.

1041 Traut, H. X-CHROMOSOME LOSS INDUCED BY LOW x-RAY DOSES IN MATURE AND IMMATURE OOCYTES OF Drosophila melanogaster. Mutation Res. 4, 4 (1967) 510-513.

X-chromosome loss is a useful criterion for the radiation sensitivity of oocytes. D. melanogaster females, 7 ± 1 d old, of the genotype y sc^{S1} In49 sc^{S}; bw; st were used and immediately mated with normal Berlin wild males. Actually y is the only marker necessary to distinguish F_1 XO males (phenotype y^+) and XXY females (phenotype y) from the regular offspring (y^+ females and y males). The experimental procedures are described. Only sterile y^+ males were counted as males resulting from X loss. Subsequent calculations show that in the low dose range from 0-400 R the frequency of x-ray- induced X-chromosome loss is ~ 30 times higher for stage 14 oocytes than for stage 7, i.e., by an order of magnitude greater than has been reported by other workers. The data might be utilised as an argument for the high efficiency of stage 7 oocytes in repairing radiation-induced chromosome breaks.

1042 Traut, H. x-RAY INDUCTION OF 2: 2: 3 TRANSLOCATIONS IN MATURE AND IMMATURE OOCYTES OF Drosophila melanogaster. Genetics 56, 2 (1967) 265-272.

Resistance to induction of autosomal translocations proved characteristic only of stage 7 oocytes (and the earlier stages), while in stage 14 translocations were readily induced. Doses of 500, 1000 and 4000 R were used. With 500 R, the translocation frequency was about 100 times greater for stage 14 than for stage 7. Differential restitution of radiation-induced chromatid breaks together with differences in the spatial arrangement of the chromosomes in the two oocytes stages is proposed to explain this great difference in sensitivity. For stage 14 the frequency of translocation obtained by irradiation with 1000 R is significantly lower than that obtained with 500 R. The departure even from a linear, and much more so from a quadratic dose-effect relationship is highly significant. It is suggested that this decrease in translocation frequency with increasing dose is caused by a close connection between the induction of autosomal translocations and dominant lethals.

1043 Traut, H. DOSE-EFFECT RELATIONSHIP OF AUTOSOMAL TRANSLOCATIONS INDUCED BY x-RAYS IN MATURE OOCYTES OF Drosophila melanogaster. Int. J. Radiat. Biol. 12, 6 (1967) 583-586.

A flattened shape is obtained for the dose-dependence curve of the frequency of 2:3 translocations induced by x-rays in mature oocytes of D. melanogaster. It was plotted for doses of 250, 500, 700, and 1000 R. A significant ($P \leq 0.05$) departure from the $\frac{3}{2}$ power rule in the dose-effect relationship was observed. (This difference is not significant as calculated by the χ^2 method using Yates' correction

for continuity.) For x-ray doses < 500 R administered to mature sperm the translocation frequency is directly proportional to the dose (not to its square). For pure samples of mature oocytes at low doses a linear dose-effect relationship may also be expected.

1044 U, R., Mittler, S. EFFECT OF IONIZING RADIATION AND INCIDENCE OF TRIPLO-X FEMALES IN OFFSPRING OF ATTACHED-X Drosophila melanogaster. Radiat. Res. 31, 3 (1967) 613. Abstr. Eb-4, at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Oregon-R males, 1-12 h old, were irradiated with 1500 R of x-rays and mated every 3 d to a new harem of attached-X y w f at a ratio of one male to three females. The appearance of exceptional females (usually y^+ w^+ f^+ and rough eyes, dumpy wings, twisted abdomen) in F_1 are result of an egg containing the attached X's, fertilized by a normal X-bearing sperm which results in a triplo-X chromosome zygote with diploid number of autosomes. These zygotes supposedly rarely develop into the adult fly. However, 4.3% of the spontaneously arising triplo-X females in the offspring of the control group survived as compared to 2.7% for the group in which males were treated with 1500 R of x-rays. A statistical analysis by 2 x 2 contingency table showed a Chi-square of 25 which is a significant difference between the two groups. Since spontaneously arising triplo-X females do survive more frequently than in the irradiated group, the decrease in the number which survive is a measure of radiation induced damage either to the autosome chromosomes or to gamete as a whole. The time for maturation of triplo-X females into adult flies was usually 4-6 d behind that of her normal siblings. The various physical expressions of triplo-X females are discussed. (Abstr.)

1045 Vatti, K.V. ON FREQUENCY OF x-RAY-INDUCED CHROMOSOME BREAKS AT VARIOUS STAGES OF Drosophila melanogaster SPERMATOGENESIS. Genetika No.3 (1966) 98-100. (In Russian)

Breaks of the ring X-chromosome of Drosophila induced by various x-ray doses (100-3000 R) at different stages of spermatogenesis were studied. It was found by means of the brood pattern method that frequency of breaks is characterized by a linear dependence on the irradiation dose at meiotic and postmeiotic stages of spermatogenesis. In contrast to this the spermatogonia do not follow such a dependence pattern within the same dosage range and are characterized by a number of breaks, approaching that of the control. A connection between breaks frequency and male fertility was observed due to irradiation of different stages at spermatogenesis. Thus increase of breaks number due to irradiation of spermatids with massive doses resulted in stressed fertility decrease; decrease of breaks number in irradiated spermatogonia caused stressed fertility increase, which is tentatively explained by an irrepairable elimination of the damaged spermatids and a simultaneous substitution of damaged spermatogonia for intact cells. A dependence of breaks frequency induced in the spermatogonia on the stage of ontogenesis being irradiated was also found. (Auth.)

1046 Wagoner, D.E. LINKAGE GROUP-KARYOTYPE CORRELATION IN THE HOUSE FLY DETERMINED BY CYTOLOGICAL ANALYSIS OF x-RAY INDUCED TRANSLOCATIONS. Genetics 57, 3 (1967) 729-739.

Males, 4-6 d old, were irradiated in gelatine capsules, 2000 to 2750 R x-rays being administered at an approx. dose rate of 280 R/min. Cytological studies of induced translocations in the housefly, Musca domestica L., showed that the five linkage groups previously reported by other workers belong to the five pairs of autosomes also previously reported. No sex-linked mutants have been found thus far. The correlation of the linkage groups to particular chromosomes as seen cytologically had not been previously attempted and was the objective in this work. The new assignment of linkage groups to particular chromosomes (made by using Perje's numbering of the housefly karyotype with X and Y representing the sex chromosomes and Roman numerals I to V representing the autosomal pairs starting with I as the longest pair and ending with V as the shortest pair) shows the Rl marker and its associated linkage group located on chromosome I, the car marker and its linkage group on chromosome II, the bwb marker and its linkage group on chromosome III, the rb marker and its linkage group on chromosome IV, and the ocra marker and its linkage group on chromosome V.

1047 Wallace, B. NATURAL AND RADIATION-INDUCED CHROMOSOMAL POLYMORPHISM IN Drosophila. Mutation Res. 3 (1966) 194-200.

The retention of x-radiation-induced inversions in small populations of D. pseudoobscura whose parental flies were from different geographic origins is discussed. 50 populations were studied; five were found to be polymorphic for newly induced autosomal inversions 6 months to 1 yr later;

three of these polymorphisms persisted for another 2 yr when the experiment was terminated; three of the five original polymorphisms involved chromosome-II, a chromosome that is generally monomorphic in natural populations. The restriction of naturally occurring polymorphisms in this species to chromosome-III cannot be explained, then, by the absence of fitness heterosis in individuals heterozygous for genes on other chromosomes. Nor can such a lack of fitness heterosis explain the tendency for closely related species (such as D. pseudoobscura and D. persimilis) to utilise homologous chromosomes for adaptive polymorphisms. Alternative possibilities are discussed. (Auth.)

1048 Warters, M. X-AUTOSOMAL TRANSLOCATIONS OF Drosophila melanogaster. Final Report. TID-23233, Centenary Coll., Shreveport, La. Dept. of Biology. 1966, 12p.

Studies on D. melanogaster were aimed at developing a technique that would make possible the recovery of all X;autosomal translocations and the maintenance of them as a balanced stock. Further, a cytological analysis of a representative sample of X;autosomal translocations was made in an effort to determine the difference between those that were male fertile and those that were male sterile. Using the procedure of Lindsley, 274 translocations were found from 2188 tested genomes distributed in classes T(X;2), T(X;3), T(X;2;3), and T(2;3). Sex-linked recessive lethals suppressed by the Y-chromosome were analysed and are presented in tabular form. Differences between male fertile and male sterile translocations were established cytologically. With the exception of a few very complex rearrangements, the exact breakpoints as lettered subdivisions and the new chromosome sequence of each was determined, and analysed in terms of heterochromatin and euchromatin. (NSA 20:1966, 42709)

1049 Zimmering, S., Johnsen, R.C., Fowler, G. POISSON ANALYSIS ON THE DISTRIBUTION OF x-RAY-INDUCED CROSSOVERS IN SPERMATOCYTES OF Drosophila. Can. J. Genet. Cytol. 8 (1966) 216-219.

Drosophila males of the autosomal composition dp cn bw/+++ were x-irradiated 1-2 h after the onset of the prepupal stage with 1000 R and upon eclosion brooded each day for 5 d with 3 dp cn bw females. For each brood, crossover data for the dp-cn region were analysed to determine their fit to the Poisson distribution. There was no good evidence of a significant deviation from this distribution in broods 1-4 representing the recovery of late and early spermatocytes, and possibly late spermatogonia (in broods 3 and 4). Brood 5 was characterized by a steep rise in population size and a marked deviation from Poisson distribution indicating the recovery of earlier spermatogonia. Failure to find a significant deviation in spermatocytes suggested that 1 crossover of the complementary pair was not recovered, that is, each recovered crossover arose from an independent event. The data appear to satisfy the prediction from the Peacock-Erickson model postulating the existence of a functional and a non-functional pole at meiosis I, but alternative possibilities are discussed. (NSA 21:1967, 22385)

1050 Zimmering, S., Johnsen, R.C. SIMULTANEOUS MEASURE OF x-RAY INDUCED X-Y AND AUTOSOMAL CROSSINGOVER IN SPERMATOCYTES OF Drosophila. Z. Vererblehre 98 (1966) 137-140.

x-rays induce crossingover between X- and Y-chromosomes in primary spermatocytes of Drosophila. A study of the relation between the pattern of induced X-Y and autosomal crossingover suggested that the two patterns are different. Radiation-induced X-Y and autosomal crossingover was followed in primary spermatocytes of Drosophila males. Males of the composition $\underline{y}/\underline{B^s}\underline{Y}^+$ were irradiated 1-2 h after the prepupal stage and mated daily with 3$\underline{y}$; dp cn bw females. The results indicated that the frequency of recovered X-Y crossovers is highest in the late spermatocyte stage about to undergo the 1st meiotic division, whereas the peak frequency of autosomal crossovers occurs in earlier spermatocytes. The results are explainable if (1) a more appropriate pairing configuration exists between X and Y than between autosomes at later stages of the primary spermatocyte, a situation which is reversed in earlier stages; (2) breakability of Y (and/or X) heterochromatin and centromeric heterochromatin of autosomes are different from each other at different stages of the primary spermatocyte; or (3) a combination of both. (NSA 21: 1967, 18026)

See also:

919 Effects of radiation on cells. (Borstel, R.C. von, 1966)
945 Spermatogonial crossing over in Drosophila melanogaster and Drosophila ananassae. (Kale, P.G., 1967)

951 Can Drosophila spermatozoa be used in studies of recovery processes? (Lüning, K.G., 1961)

961 A survey of methods for the induction of aberrations in meiotic stages in Drosophila females and for observation of their disjunctional properties in the ensuing meiotic divisions. (Parker, D.R , 1967)

962 ibid.

983 Meiotic X-Y exchange and nondisjunction induced by x-rays in primary spermatocytes of male Drosophila melanogaster. (Wu, C.K., 1967)

984 Induced mutations and lethality in Drosophila after x-irradiation of meiotic and post-meiotic stages of the egg. (Würgler, F.E., 1968)

986 Meiotic X-Y exchange and nondisjunction induced by irradiation in the Drosophila male. (Zimmering, S. et al., 1964)

1062 Dependence of radiation induced mutation rate on maturity and dose for chrysalis of Drosophila melanogaster Meigen. (Ebeling, W., 1962)

1121 The theory of radiation-induced dominant lethality in sperm. (Borstel, R.C. von, 1966)

1139 Sterility, chromosome breakage, x-ray-induced mutation rates and detected mutation frequencies in Drosophila melanogaster. (Lefevre, G., Jr., 1967)

1150 x-Radiation induction of mutations in Habrobracon. (Smith, R.H. et al., 1966)

1152 Mutation pattern in two wild-type stocks of Drosophila melanogaster. (Strømnaes, Ø., 1959)

1175 Influence of arginine on radiation damage of spermatids and spermatocytes in Drosophila. (Abeleva, E.A., 1965)

1179 Investigation of the complex effect of ionizing radiation and other factors of space flight on the organism. (Antipov, V.V. et al., 1966)

1180 Results of biological investigations conducted during flights of "Vostok" type vehicles with the participation of cosmonauts A.G. Nikolayev, P.R. Popovich and V.F. Bykovskiy. (Antipov, V.V. et al., 1966)

1190 "Research in Genetics to include: (1) The direct and indirect effects of radiations and their modification on genetic systems, and (2) population and evolutionary studies of Drosophila". (Elequin, F.T. et al., 1966)

1191 Modification of induced genetic damage in Drosophila melanogaster by oxygen and argon treatments between two doses of x-rays. (Elequin, F.T., 1966)

1203 AET and radiation induced crossing-over in male D. melanogaster. (Mittler, S., 1965)

1204 ibid (1966)

1205 Modification of radiation induced chromosome loss by ATP in Drosophila. (Mittler, S. et al., 1966)

1206 Effect of urethane and colchicine on radiation-induced chromosome loss in male Drosophila. (Mittler, S. et al., 1966)

1207 Adenosine triphosphate: protection against radiation-induced chromosome loss in Drosophila.

1208 Effect of ATP upon radiation induced chromosomal aberrations in Drosophila. (Mittler, S. et al., 1967)

1221 Influence of helium posttreatments and exposure fractionation on x-ray induced dominant or sex-linked recessive lethality and X-chromosome loss in stage 7 oocytes of Drosophila melanogaster. (Rinehart, R.R , 1967)

1230 Effect of ethylene-diaminetetraacetic acid sodium salt on the process of crossingover in different lines of Drosophila melanogaster. (Sikha, S.P., 1965)

1234 The contrasting effects of O_2 and N_2 in determining initial sensitivity and post-radiation recovery in Drosophila sperm and spermatids. (Sobels, F.H., 1964)

1235 Processes underlying repair and radiosensitivity in spermatozoa and spermatids of Drosophila. (Sobels, F.H , 1966)

1236 Repair of radiosensitivity phenomena in Drosophila males. (Sobels, F.H. et al., 1967)

1237 RBE values for genetic effects of 15 MeV neutrons in relation to stage sensitivity in Drosophila. (Sobels, F.H., 1967)

1246 Genetic x-radiation damage and its modification by some gases and a time factor in Drosophila melanogaster. (Yoon, J.S., 1966)

1251 Genetic damage induced in the sex chromosome and autosomes, with x-ray and ethylenimine treatments. (Alexander, M.L., 1967)

1259 A comparison between the effects of x-rays and heat treatment on recombination in the X-chromosome of Drosophila melanogaster. (Chandley, A.C., 1966)

1260 Biological organization in relation to differential gene response to mutagens. (Fahmy, O.G. et al., 1965)

1263 The action of radiation and other mutagenic agents 1. in inducing mutation in Drosophila females, and 2. in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, H. B., 1966)

1273 Cytological analysis of formaldehyde induced chromosomal changes in Drosophila melanogaster (Slizynska, H., 1957)

1285 Brood data on crossover recovery from pretested heated adult females. (Whittinghill, M., 1964)

1395 Studies on the radiosensitivity of early embryonic stages of Drosophila melanogaster. (Würgler, F.E., 1964)

1419 Estimation of sensitivity of Drosophila melanogaster to radiation using a third-order rotable design. Three Year Comprehensive Report. (Ratty, F.J.,1966)

1492 Chromosomal polymorphism in irrdiated natural populations of Chironomus. (Blaylock, B.G., 1966)

1493 Cytogenetic study of a natural population of Chironomidae inhabiting an area contaminated by radioactive waste. (Blaylock, B.G., 1966)

1494 Population genetics and radiation effect studies.(Blaylock, B.G., 1966)

1506 On the interaction between the chromosomes carrying the detrimental genes or gene blocks in viability. (Matsudaira, Y., 1965)

1518 The fate of x-ray induced chromosomal rearrangements introduced into laboratory populations of Drosophila melanogaster. (Vann, E., 1966)

1519 A genetic analysis of induced chromosomal rearrangements in laboratory populations of Drosophila melanogaster. (Vann, E.G., 1966)

2.1.5. Recessive Mutations. Visible Mutations. Subvital and Sex Ratio Effects

1051 Altenburg, E., Browning, L.S. COMPARATIVE VISIBLE MUTATION RATES IN THE X-CHROMOSOME OF Drosophila AT VARIOUS STAGES IN OOGENESIS. Drosoph. Inf. Serv. 41 (1966) 95-96.

Among approx. 40 580 female progeny of Muller's Vix stock (heterozygous at 13 visible loci in the X-chromosome), a total of 77 mutations (45 whole body and 32 mosaic) were recovered at the visible loci under study, or about 1 in 530, after treatment of the female parents with CB 1506 (2-chloroethyl-methanesulfonate) vapour, and about a 20% sex-linked lethal rate from a smaller sample. Most of these mutations were recovered in the first five 3-d brooding periods, but none among the relatively few progeny in the first brood, in which most of the oocytes treated in stage 14 would be represented. On the basis of work reported by R. Valencia, we calculate that the mutation rates at the same loci as the above (but in Muller's "jynd" stock) were about ten times as high after x-ray treatment of stage 14 oocytes (the stage studied by Valencia) than the rate we recovered after treatment of the earlier stages of oogenesis with an equivalent mutagenic dose of CB 1506. The "equivalence" is based on the lethal rates induced by the agents under study, and on the assumption that the lethal rates induced by radiation of earlier stages in oogenesis (not obtained in our experiments) would be about the same as the rates usually recovered after radiation of the mature sperm cells, though actually they are somewhat lower in the former than the latter case. The visible rates, relative to the lethal, were not widely different after x-ray treatment of stage 14 oocytes, as reported by Valencia, and CB 1506 treatment of the earlier stages, herein considered. The extreme radiosensitivity of stage 14 oocytes has been pointed out by Valencia. (Auth.)

1052 Anonymous. PRESERVING FOOD BY RADIATION: SAFE OR UNSAFE. Sci. Cult. Calcutta 33 (1967) 364-365.

Objections to the use of radiation for preservation of food are discussed. In some cases an unpleasant flavour is produced by radiation. Another objection is the high cost of equipment. The association of radiation with harm to human beings causes prejudice against radiopreservation of food, even though many experiments failed to produce evidence that irradiated food is harmful. Harmful mutations developed in fruit flies fed on heavily irradiated food. It is pointed out that rats, pigs,

mice, and monkeys fed on irradiated food over a period of 10 yr failed to show any evidence of harmful effects. (From NSA 22: 1968, 21642)

1053 Baldwin, W.F., Cross, W.G. EFFECTS OF FAST NEUTRONS ON EYE COLOR MUTATIONS IN Dahlbominus. Nature, Lond. 210 (1966) 1396-1397.

The mutagenic effects of 14-MeV neutrons as compared to ^{60}Co γ-rays in adult females of D. fuscipennis were studied. The numbers of four classes of eye colour mutants (carmine, claret, chestnut, and russet) were scored following exposure of Dahlbominus adults. The total dose, whether of neutron or of γ-rays, was about 750 rad. The neutron exposures produced about 30% more mutations. However, as the age of the insects at the time of exposure was increased from 12-108 h, the frequency of mutations rose about twofold for both neutrons and γ-rays. Overlapping of the standard limits for each age group demonstrated that no significant differences were detected between the results with γ-rays and with neutrons. (NSA 20: 1966, 33023)

1054 Baldwin, W.F. AN INCREASED YIELD OF GAMMA INDUCED EYE COLOUR MUTATIONS FROM CHRONIC VERSUS ACUTE EXPOSURES IN Dahlbominus. To be published in the Proceedings of the "IAEA Symposium on the Use of Isotopes and Radiation in Entomology. Vienna, Austria, 4-8 Dec. 1967".

1055 Baldwin, W.F. AN INCREASED YIELD OF GAMMA INDUCED EYE COLOUR MUTATIONS FROM CHRONIC VERSUS ACUTE EXPOSURES IN Dahlbominus. AECL-2791, Atomic Energy of Canada Ltd., Chalk River (Ontario). Nov. 1967, 7 p. Paper SM-102/29 also presented at "IAEA Symposium on the Use of Isotopes and Radiation in Entomology. 4-8 Dec. 1967, Vienna, Austria". (See 1054, above)

Susceptibility to induced mutation reaches a plateau in aging females at ~9 d after they become adult, and over the following 4 d the mutation rate maintains a comparatively constant frequency. Accurate records of the number of cocoons parasitized by Dahlbominus, and the number of progeny per female, have made it possible to test for differential killing by seeing if decreased fecundity is associated with a depression of mutagenic rates. Studies of the effects of 500 rad of γ-radiation delivered chronically over the period of comparable sensitivity, i.e. over 100 h from 9-13 d after the pupal stage, and of the same dose as acute exposures at different times in this period are now complete, and are complemented by similar studies using 250 rad. The results with 500 rad indicate an approx. 20% greater mutagenic effect of the chronic as compared with the acute exposures. The results of 250 rad show that the difference in mutation frequency as compared with chronic doses is less at this lower exposure, implying that the difference in effect is probably the result of a disproportionately greater killing by the acute irradiation of cells which would have produced mutations. Records of parasitization and the number of progeny per female following acute and chronic exposures at 500 and 250 rad give conflicting results, indicating that differential killing may not be a factor determining mutagenesis. The results are based on 923 eye colour mutations in a total of 346171 flies scored. (From auth.)

1056 Bartlett, A.C., Bell, A.E. "IVORY", AN EYE-COLOR MUTATION IN Tribolium castaneum. Ann. ent. Soc. Am. 59, 4 (1966) 865-866.

The ivory mutant was isolated from an x-rayed population under selection for large body size (strain LCS in ref. 1487). Preliminary data suggest that ivory and pearl are closely linked and at approximately equal distances from pegleg. The occurrence of ivory further emphasizes the need for study of possible homologies between mutants in other species, as well as the biochemical relationships between similar mutants of the same species. Biochemical study of the two eye mutants, pearl and ivory, might yield significant information concerning the biosynthesis of eye pigments in both Tribolium and other insects.

1057 Ben-Zeev, N., Falk, R. ABSENCE OF Y-SUPPRESSED LETHALS IN AN AUTOSOME OF Drosophila. Mutation Res. 3 (1966) 174-176.

Male D. melanogaster were exposed to 3-4 kR x-radiation and mated three times, on days 1-3, 3-5, and 5-9 after irradiation. The frequency of chromosome lethals in offspring was determined for each group. Data are included on the constitution and phenotypes of the sex chromosomes of each

test generation. Not a single Y-suppressed lethal was found in the second chromosome although 15-18 were expected by the standard of the X-chromosome. Possible explanations are suggested. (NSA 20: 1968, 28683)

1058 Bender, H. A. RADIATION INDUCED TANDEM DUPLICATIONS IN Drosophila melanogaster. Genetics 55, 2 (1967) 249-254.

Tandem direct duplications of the lozenge (*lz*) region have been induced by x-irradiation of the diploid meiotic stages of the female. Detection was based upon partial complementation between two of the *lz* pseudoallelic mutants, and the duplications were confirmed by cytological and genetic analysis. (Auth. summary)

1059 Bowman, J. T., Jr., Green, M. M. x-RAY INDUCED REVERSION OF THE WHITE-IVORY MUTANT OF Drosophila melanogaster. Genetica 37 (1966) 7-16.

Following x-irradiation, w^i reverts in oogonia and in spermatogonia. Following treatment of adult females, w^i reverts equally frequently in homozygotes and deficiency heterozygotes. Induced reversions are commonly recovered as clusters, indicating that they are of gonial origin. In contrast to w^i, two partial reversions recombine normally with w^{ch}. One of these has been tested for x-ray-induced reversion and found to be stable. (Auth.)

1060 Conner, G. W. PREFERENTIAL SEGREGATION IN Mormoniella. Genetics 54 (1966) 1041-1048.

In the parasitoid wasp M. vitripennis (Walker) many eye-colour mutations had been obtained with x-rays, fast neutrons, and slow neutrons. Three different types of crosses are possible involving triple complementary allelic genes affecting eye colour in Mormoniella. Females homozygous for each gene are mated to males compound for the other two. Because diploid males produce diploid sperm, triploid females result having one maternal gene and two paternal. Such females unmated produce six types of sons, three haploid and three diploid, which are to be expected in equal numbers. Previously reported data are inadequate to test whether the maternal type appears in excess because of being maternally contributed or because of some innate quality of the gene itself. The new data of the present paper are derived from the three possible three-gene tests with oyster, scarlet, and dahlia females and wild-type males compound for each two of the recessives. Haploid F_2 males of the maternal type were in highly significant excess over the expected $\frac{1}{8}$ in each case, totalling 3937 maternal and 5856 "recombinant" (with paternal genes). - Diploid males are in all cases low in number, fluctuating about 40% of the haploid. Excess of the maternal type among the haploids and deficiency of diploids are explained by excess of hexad divisions separating the maternal from the two paternal chromosomes and by excess of diploids among the polar nuclei. This preferential segregation in Mormoniella eggs is compared with loss of paternal chromosomes in spermatogenesis of Sciara and of lecanoid coccids, which appear to be the only hitherto reported cases of non-random segregation dependent upon parental origin rather than upon the nature of the chromosomes themselves.

1061 Dinu, M., Popa, A., Adler, A., Dumitrasc, N., Tanasescu, R. EFFECT OF IONISING RADIATION ON THE ONTOGENETICAL DEVELOPMENT AND SEX OF Bombyx mori. Lucr. stiint., Ser. C 9 (1966) 199-213. (In Rumanian)

1062 Ebeling, W. DEPENDENCE OF RADIATION INDUCED MUTATION RATE ON MATURITY AND DOSE FOR CHRYSALIS OF Drosophila melanogaster Meigen. Thesis, Technische Hochschule, Darmstadt (West Germany). 1962, 100p.

The dependence of the rate of radiation-induced recessive sex-linked lethal factors and II-III translocations on dose and maturity of germ cells of 174-h-old chrysalis are studied. For the translocation curves, an exponent of approx. 1.5 was observed. Dose curves for lethal factor have an exponent smaller than unity. This can be explained by assuming that for increasing dose a larger fraction of lethal factors for which at least two events are necessary is produced. (Gmelin Inst.) (NSA 17: 1963, 30397)

1063 Falk, R., Ben-Zeev, N. VIABILITY OF HETEROZYGOTES FOR INDUCED MUTATIONS IN Drosophila melanogaster. II. MEAN EFFECTS IN IRRADIATED AUTOSOMES. Genetics 53 (1966) 65-77.

The viability of flies heterozygous for unselected samples of irradiated II-chromosomes was studied in repeated tests in different genotypic combinations. A dose of 2000R* caused no significantly detectable reduction in the viability of heterozygotes for irradiated chromosomes. The slight effect suggested by the results could be due to induced lethals. Severe detrimental mutations were rare, and only 10-20% of the deleterious effect in homozygotes was due to non-lethals. It could not be decided whether their effect in heterozygous condition was too small or whether they had no effect at all. (Auth.)

* x-rays

1064 Falk, R. VIABILITY OF HETEROZYGOTES FOR INDUCED MUTATIONS IN Drosophila melanogaster. III. MUTATIONS IN SPERMATOGONIA. Mutation Res. 4, 1 (1967) 59-72.

A random array of mutations was obtained by irradiating D. melanogaster with x-rays. Irradiation was given in 1, 2 and 4 instalments of 4000 R each. Only chromosomes irradiated in spermatogonial stages were sampled. There was a significant increase in the mean viability coefficient of heterozygotes for the series of chromosomes irradiated with 6000 and 12000 R. In these two series many mutations were induced which drastically reduced the viability of the homozygotes: only about 20% of the homozygotes for chromosomes irradiated with 12000 R were in the normal range. On the other hand, the number of flies heterozygous for the irradiated chromosomes in tests designed to determine viability of homozygotes indicated that the induced detrimental mutations were not completely recessive. The contrast between the findings of the two parts of the experiments are considered in relation with the current hypotheses on the effect of induced mutations on viability. Since the genetic background of the flies was highly heterozygous even before irradiation the viability of the heterozygotes for induced mutations was expected to decrease according to all current hypotheses. Probably the increased viability coefficients were biased by factors other than viability, but it would be premature to suggest at this stage a hypothesis that explains all the findings satisfactorily. (Auth. summary)

1065 Falk, R. VIABILITY COEFFICIENTS AND PREFERENTIAL RECOVERY. Mutation Res. 4, 6 (1967) 821-830.

The proportion of progeny heterozygous for two marked balancer chromosomes varied in reciprocal matings. Preferential segregation of the marker chromosomes, either in females or in males, was suspected. Adult males of Drosophila were irradiated with x-rays. When irradiated chromosomes were transmitted to progeny by their fathers the induced mutations appeared to give heterotic effects. The effects were, however, detrimental when the irradiated chromosomes were transmitted to the progeny by their mothers. This difference was ascribed to slight preferential segregation caused in males by many of the induced detrimental mutations.

1066 French, W.L., Kitzmiller, J.B. TESTS FOR MULTIPLE FERTILIZATION IN Anopheles quadrimaculatus. p. 374-380 of "19th Annual Meeting of the American Mosquito Control Association", and the "50th Annual Meeting of the New Jersey Mosquito Extermination Association, Atlantic City, N.J., USA, 12-15 Mar. 1963".

In the course of a study on x-ray induced mutations in the Bethesda strain several morphological markers were found. One of these was a variation in the colour pattern of the dorsal portion of the thorax and abdomen. In some of the larvae, a broad, brightly pigmented white mid-dorsal stripe was found, entirely lacking in others. These genetic markers proved extremely useful since they can be recognized in three stages of mosquito development; easily in the larvae, the pupae, and with some difficulty in the adult. Using the dominant stripe and recessive non-stripe markers it could be shown that multiple fertilization of young A. quadrimaculatus females does not occur when they are placed in a cage with males of the same age under the experimental conditions described. When the males and females which vary in age from 3-17 d are present in the same cage multiple fertilization may occur but with a relatively low frequency. The presence of active Aedes aegypti in a cage with A. quadrimaculatus appears to stimulate copulatory activity of the Anopheles as assayed by a higher frequency of multiple insemination.

1067 García-Bellido, A. FENOGENETICA DEL LOCUS "FURROWED" (fw) DE Drosophila melanogaster. I. ESPECIFICIDAD DEL SINDROME PLEIOTROPICO. (Phenogenetics of the locus "furrowed" of Drosophila melanogaster. I. Specificity of the pleiotropic syndrome). Genet. iber. 15, 1/4 (1963) 1-74. (In Spanish, with English summary)

Of the three alleles of furrowed (fw) studied, two were recovered following irradiation of spermatids with low x-ray doses (fw^{59} and fw^{60}); the 3rd was spontaneous in origin (fw^{0}). These alleles are all recessive to the normal Oregon-R. The phenotype of the mutants is highly variable. The penetrance of the syndrome depends upon the nutritional background of the larvae. The females show decreased fecundity but normal fertility. The syndrome appears in all three alleles, with different and decreasing expression of the abnormal trait for each allele. The sequence is $fw^{59} > fw^{60} > fw^{0}$, fw^{+}. The expression of the individual traits varies in correlated fashion under experimental conditions. This suggests that a common epigenetic mechanism governs behaviour of these alleles. (BA)

1068 Glembotskiĭ, Y.L., Abeleva, E.A., Grozdova, T.Y., Myasnyankina, E.N. MOSAICISM OF INHERITANCE OF SEX-LINKED RECESSIVE LETHALS OF Drosophila melanogaster IN CONNECTION WITH CHROMOSOME STRUCTURE. p. 188-200 of "Vliyanie Ionizirovannykh Izluchenii na Nasledstvennost". Dubinin, N.P., Ed. Moscow, Izdatel'stvo Nauka. 1966. (In Russian)

The purpose of this investigation was to elucidate the mechanism for the development of gonadal mosaicism, and hence solve the problem of the chromosome structure in gametes at post-meiotic stages of their development from one or two threads, and to clarify the problem of the relative frequency of the occurrence of chromatid sex-linked recessive mutations in comparison with the frequency of such chromosome mutations. It was shown that chromatid, along with chromosomal, sex-linked recessive lethals occurred following irradiation of the male gametes of Drosophila at postmeiotic stages. During γ-irradiation in a dose of 1000 R they amounted to 21% of the number of chromosome mutations, and during irradiation by 1-MeV fast neutrons in a dose of 1000 rad + 250 R of γ-rays, they amounted to 13% of the number of chromosome mutations. The question of the time of formation of chromatid point mutations, whether directly in the irradiated gametes or in the zygote as a result of the secondary effect of irradiation, was left unsolved. (NSA 22: 1968, 21483)

1069 Glembotskiĭ, Ya.L., Abeleva, E.A., Grozdova, T.Y., Myasnyankina, E.N. CAUSES OF VARIEGATED INHERITANCE OF RECESSIVE SEX-LINKED LETHAL MUTATIONS IN Drosophila melanogaster. Genetika No. 3 (1967) 68-75. (In Russian)

The appearance of F_1 individuals, in which only a part of their body bears a mutation, following the treatment with chemical mutagens or radiation, is usually explained as the results of multi-stranded chromosome structure in mature spermatozoa. Since it was already shown earlier that the mutations can take place in the non-irradiated chromosomes of the ovules fertilized by the irradiated male germ-cells, an assumption was made that the occurrence of partial mutants can be accounted for by the action on the chromosomes of cells, during the 1st stages of the zygote cleavage, of the mutagenic agent formed as the result of the irradiation and introduced by the spermatozoon. This hypothesis also apparently explains the low frequency of the detection of such mosaic individuals and the relatively high efficiency of chemical mutagens. In these studies the frequencies of chromosome and chromatid sex-linked lethals and sublethals were determined both in the directly irradiated chromosomes of males (doses of 1000 and 1500 R of x-rays and γ-rays) and in the chromosomes of eggs that had not been irradiated but had been fertilized by irradiated male gametes (dose 1500 R of γ-rays). It was established that the frequencies of chromatid mutations in the directly irradiated chromosomes are 5-6 times as high as those in the non-irradiated chromosomes. No chromatid lethals were ever found in the non-irradiated chromosomes. Therefore the appearance of partial mutants can be associated with the delayed effect of irradiation to but an insignificant extent. (NSA 21: 1967, 20136)

1070 Green, M.M. THE GENETICS OF A MUTABLE GENE AT THE WHITE LOCUS OF Drosophila melanogaster. Genetics 56, 3 Pt. 2 (1967) 467-482.

The origin of the frequently mutating gene, w^{c}, white crimson, as a derivative of w^{i}, white-ivory, is described which initially involved the treatment of attached-X females homozygous $w^{i}spl$ with ~4000 R x-rays and their subsequent crossing with $y^{2}sc\ w^{i}\ spl$ males. w^{c} mutates spontaneously in both females and males to a number of different allelic states the phenotypes of which range from

w^+ to w. The mutation event appears to occur primarily, if not exclusively, before meiosis and appears not to involve any recombination or similar event. Alleles derived from w^c may be stable or mutable. In addition to apparent point mutations, w^c and its mutable derivatives produce deficiencies which include loss of the w gene and adjacent loci to the right or left of w. The causes of the high mutation rate are discussed in terms of an autonomous event and of an event controlled by a "foreign" element akin to the controlling elements demonstrated for maize.

1071 Gros, C.M., Weill, F. THE RADIOLOGIST AND PRACTITIONER IN RELATION TO THE SUPPOSED HAZARDS OF x-RAYS IN RADIODIAGNOSIS. Strasb. méd. 13 (1962) 259-276. (In French)

Genetic risks are also considered, especially experiments on Drosophila showing an increase from 0.13%-3% in the mutation rate for 1000 R, with 40-60 R doubling the natural rate. For man, results are not conclusive, but it is estimated that 10 R/gonad would double the mutation rate and that a dose of 1 R would increase it by 0.25%. Somatic effects of small doses have not been conclusively established, but a more firm basis exists for genetic effect. It is concluded that, for small doses, a genetic effect has been proved experimentally on animals, and only by extrapolation on humans, and that radiologic examination is no more dangerous than other methods of diagnosis or than natural radiation itself.

1072* Hochmann, B., Gloor, B., Green, M.M. ANALYSIS OF CHROMOSOME 4 IN Drosophila melanogaster. I. SPONTANEOUS AND x-RAY-INDUCED LETHALS. Genetica 35 (1964) 109-126.

An analysis of 17 spontaneous and 37 x-ray-induced lethal mutations on the IV-chromosome of Drosophila melanogaster has revealed a min. of 22 loci on this microchromosome capable of mutating to lethality. A few of these loci had been identified earlier by their visible alleles, but 16 are new discoveries. Seven of the 22 lethal loci are situated within that proximal section of the right arm of chromosome IV delimited by the Minute-4 deficiency. Genetic tests indicate that two translocations and five deletions are included among the lethals of x-ray origin. No chromosomal aberrations were found among the spontaneous mutants. Allelism was encountered both within and between lethals from the two groups. Three independent estimates of the total number of lethal loci to be expected on this small autosome are presented. These appraisals are based on: the size of the Minute-4 deficiency; the number of bands in salivary chromosome 4; and the frequency of recurrence among the lethals. Considering the uncertainties inherent in each determination, the three estimates show remarkably good agreement. (Auth.)

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* Originally (III 599) cited without abstract.

1073 Hughes, A.M., Hildreth, P.E. THE PRODUCTION OF A NEW MUTANT IN D. melanogaster BY LOW DOSES OF TRITIUM IRRADIATION.* Drosoph. Inf. Serv. 42 (1967) 86-87.

On two separate occasions, during the course of an investigation in which D. melanogaster larvae were being raised on tritiated medium, apparently identical mutants affecting adult colouration were recovered. Since these mutants originated among only a few thousand flies and only in the treated series, it appeared that ^3H might be repeatedly causing mutations at a specific locus. Therefore, further experiments were conducted in two series (1961-62, 1965-66) in order to test whether this one type of mutant could be routinely produced. Homozygous yellow (y/y) females that had mated with $y\ B^S Y y^+$ males oviposited on control or ^3H-supplemented medium where the eggs hatched, the larvae and pupae developed. For the treated series, the standard cornmeal-molasses-agar-yeast medium contained either 0.1 or 1.0 $\mu Ci\ ^3H/g$. On the basis of the table of Tolbert (1960) and assumptions of rapid equilibration between the larval body water and that of the medium, the two concentrations of ^3H used would give a max. total body irradiation of 0.5 and 5.0 R/fly during the time from hatching through eclosion. The actual irradiation is probably less. The F_1 males ($y\ B^S Y y^+$) were then individually mated to virgin yellow non-treated females and the offspring raised on control medium. The expected offspring would again be yellow females and non-yellow Bar-eyed ($y/B^S Y y^+$) males. Among the 2nd-generation offspring exceptional males were recovered; they had bar-shaped eyes and wildtype-coloured wings as in the expected class, but their bristles were yellow and bodies yellowish (but not as yellow as y/Y males) instead of wildtype. The mutant has been transmitted with the Y-chromosome ($B^S Y y^{+61d}$) through many generations. The results are

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* Lawrence Radiation Laboratory and University of California.

given in two tables. In order to determine whether other types of irradiation would produce similar mutation, experiments involving the mating procedure described were used. In the first experiment, virgin males were given 2800 R, in the second a smaller dose was used (1000 R); in the third, prepupae were collected from culture bottles, irradiated with 735 R, and then allowed to pupate and eclose. The expected offspring was the same as in the ^{3}H-experiments. Combining control and x-ray totals, the mutation rate amounts to 0.016/1000. Since both mutants were found in the same culture, the minimum number of mutant events could be 0.008/1000. In the ^{3}H-treated group, the total mutation rate is 0.148/1000, and the minimum mutant event rate 0.58/1000. In addition, in the ^{3}H-tteatment, in one culture a gonosomal mosaic for this mutant was recovered, and in another culture one mutant in the 3rd generation.

1074 Inagaki, E., Nakao, Y. COMPARISON OF FREQUENCY PATTERNS BETWEEN WHOLE-BODY AND FRACTIONAL MUTATIONS INDUCED BY x-RAYS IN Drosophila melanogaster. Mutation Res. 3 (1966) 268-272.

Male D. melanogaster were exposed to 1000, 2000, 3000, or 4000 R x-radiation and mated 2 d later with virgin females carrying four visible sex-linked recessive mutations. Careful examination of the F_1 generation was made to assess the frequencies of whole-body and fractional-appearing mutations. The data indicate an increase in the frequency of whole-body mutations with increase in radiation dose. There did not appear to be a statistically observable change in the relative frequency of fractional mutations with increase in radiation dose. The ratio of fractional to whole-body mutations tended to decrease with increasing dose in the ranges studied. (NSA 20: 1966, 38650)

1075 Kang, Y.S., Kim, Y.J., Lee, C.C., Choi, C.C. THE GENETIC STUDIES OF Drosophila POPULATION. I. ON THE FREQUENCIES OF SEX-LINKED RECESSIVE LETHAL MUTATION IN D. melanogaster IRRADIATED WITH x-RAYS. Zoologica No.3? (1964) 1-6.

1076 King, J.L. THE DUMPY LOCUS IN INDUCED MOSAICS OF Drosophila melanogaster. Thesis, California Univ., Berkeley. 1963, 69p.

Certain alleles of the gene dumpy produce changes in the configuration of the dorsal surface of the thorax and in the distribution of thoracic bristles and cell hairs, termed vortices. x-ray induction of somatic crossing over was used to produce mosaic patches, which were homozygous for dumpy and homozygous or hemizygous for yellow on a heterozygous wild type background. 13 mosaics, including eight of recessive lethal alleles, were recovered from an estimated 7000 treated individuals. In the mosaic specimens the dumpy recessives are non-autonomous: homozygous recessive patches bring about the vortex pattern in the adjacent heterozygous or possibly homozygous dominant tissue, and, in three cases, in the heterozygous tissue of the opposite side of the thorax. The doubling of bristles in the vortices is shown to be an indirect effect, since it sometimes occurs in the background tissue. It is suggested that the wild type allele of dumpy, in response to specific developmental environments, regulates the production of a supracellular factor which in turn affects tissue movement; and that the recessive alleles fail to regulate this production, which leads to abnormal tissue movement. The relationship between tissue movement and cellular determination in morphogenesis is discussed. It is concluded that dumpy is not a prepattern gene with respect to the distribution of thoracic bristles, since it does not have any effect on the determination of bristle organs. The differentiation of doubled bristles, however, is due to a change in the cellular environment which is indirectly brought about by dumpy; in this minor respect dumpy can be considered a prepattern gene. (DA)

1077 Kitagawa, O. HETEROZYGOUS EFFECT OF INDUCED RECESSIVE LETHALS ACCUMULATED ON SECOND CHROMOSOMES OF D. melanogaster. Drosoph. Inf. Serv. 40 (1965) 55.

More than 60 lethal free II-chromosomes were extracted from the heterozygous population of D. melanogaster which was maintained for 6 months. Male flies with normal viability when homozygous were irradiated by 500 R of x-rays. 34 II-chromosomes carrying induced recessive lethals were obtained. Double and triple lethals were accumulated in cis-phase on II-chromosomes through recombination of females with two or more lethals in trans-phase. In this experiment, 40 normal, 34 one, 15 double and 9 triple lethal strains were used. Hand in hand with the increase of the number of lethals per zygote, the viability decreased rapidly. This synergistic interaction between

lethals is very relevant to the problem of the maintenance of genetic loads in natural populations. (From DIS)

See also ref. 1503

1078 Kvelland, I., Strømnaes, Ø. x-RAY INDUCED MINUTES IN Drosophila melanogaster SPERM EJACULATED IN CONSECUTIVE MATINGS. Hereditas 54 (1965) 170-176.

x-ray induction of minutes was studied in individual sperm ejaculates of males that were either 0-2 h, 24 h, or 72 h old at the time of irradiation. All males went through three 12-h mating periods, the 2nd of which was without females. For all groups of males the frequency of minutes was higher in the 1st than in the 2nd mating period. The difference in frequency of minutes between age groups of males was significant when measured in the 1st mating period but insignificant in the 2nd mating period. Data supported previous reports that a change in mutation frequency does occur at an earlier time after irradiation for sperm released by young males. (NSA 20: 1966, 1836)

1079 LaChance, L.E., Dawkins, C., Hopkins, D.E. MUTANTS AND LINKAGE GROUPS OF THE SCREW-WORM FLY. J. econ. Ent. 59 (1966) 1493-1499.

Some radioinduced visible mutations in the screw-worm fly, Cochliomyia hominivorax, are described. In a programme to derive mutant strains, three techniques were used to find flies with aberrant phenotypes which could be investigated further: (1) microscopic examination of vast numbers of untreated flies (general scanning); (2) treatment of adult flies with γ-radiation or tretamine over a wide range of substerilizing doses and close examination of their F_1 progeny for inherited variations; and (3) an inbreeding programme in which a single pair of flies was used to produce a group of progeny. The F_1 (brothers and sisters) were, in turn, inbred to produce the F_2 generation. 15 genetically marked strains were derived; 13 were recessive mutations and were established as pure breeding stocks. Both dominant mutations are lethal in the homozygous condition and could not be established as a pure breeding strain. The mutation, Brc (black R-cell), was associated with a chromosome translocation (position effect). The Brc: # Blackened R-cell mutant was found in progeny from irradiated parents of a wild-type strain. It is a wing mutant in which the R-cell is blackened by dense pigmentation, and is a dominant mutation associated with a reciprocal translocation; the homozygous condition is lethal. The sh: shortened r-m mutant was among the progeny from irradiated parents of a wild-type lab strain. It is a wing mutation in which the r-m vein is shortened and without its characteristic bend. In all males the allele is penetrant and uniformly expressed; in some homozygous females, the character is indistinct. This report summarizes the data on the pure breeding strains with regard to heritability of the character, viability of the mutant genotypes in the preimaginal stages, and the linkage relations. (NSA 21: 1967, 14625)

1080 Lamb, M.J., McSheehy, T.W., Purdom, C.E. MUTAGENIC EFFECT OF 600-MeV PROTON IRRADIATION. Drosoph. Inf. Serv. 41 (1966) 156.

Experiments, comparing proton irradiations with x-irradiation (250 kVp, 15mA, HVL 1.2 mm Cu), were performed as part of a programme to investigate the relative effectiveness of different parts of the proton beam which have different LET values. Male Drosophila, 32 h old, were exposed to 600 rad of protons or x-rays at dose rates of 150 rad/min and 540 rad/min respectively. Males were mated individually to two females every 3 d, and the frequency of IInd chromosome recessive lethal mutations was scored among offspring from six successive broods. A pronounced difference between the percentage of mutations induced by protons and x-rays was found in brood IV, but otherwise no significant differences were observed. This may be explained either on the assumption that the irradiated germ cell stages contributing to sperm used in brood IV were much more sensitive to proton than to x-irradiation, or that mutagenic efficiency of protons was slightly greater than that of x-rays and a slight shift, or sampling error, during the brood sequence concentrated the effect into a single brood. The 2nd explanation is more plausible, but the results of later experiments suggested that there is no difference between these radiations. When 250-kVp x-rays (800 rad) were compared with 600-MeV protons (800 rad) and with attenuated protons in the Bragg peak (400 rad), in only one brood was there any significant deviation from an RBE value of 1 relative to x-rays. This was brood II of the 600-MeV proton series, which was significantly low.

Overall analysis, however, showed no deviation from 1 and there was no indication, therefore, that the increase in frequency of nuclear interaction in the Bragg peak region was accompanied by any increase in genetic effectiveness. (NSA 21: 1967, 22739)

1081 Lamb, M.J., McSheehy, T.W., Purdom, C.E., Baarli, J., Sullivan, A.H. THE MUTAGENIC EFFECT OF 600 MeV PROTONS IN Drosophila melanogaster. Int. J. Radiat. Biol. 12, 1 (1967) 27-34.

Comparisons have been made between the mutagenic efficiency in Drosophila of 600 MeV protons and 250 kVp x-rays. II-chromosome recessive lethal mutation frequencies were measured in six successive 3-d broods of offspring. There was no evidence of any difference between the effectiveness of x-rays and protons from the initial beam or from the Bragg peak region of the beam in inducing mutations in any of the germ cell stages sampled. (Auth.)

1082 Lee, W.R., Strangio, V.A. BROOD SENSITIVITY TO THE INDUCTION OF POLYGENE MUTATIONS. Drosoph. Inf. Serv. 41 (1966) 124.

Males from a highly-inbred wild type D. melanogaster stock were irradiated with 500 R x-rays and then mated individually to three virgin females from the same stock. Four broods were established from successive matings, each 3 d in duration. Sternopleural bristles were counted in F_1 females only. Although pooled data from all 4 broods indicate a significantly increased variance of the bristle number distributions in females from the irradiated series, the preliminary results have so far failed to reveal a detectable sensitivity pattern. (Auth.)

1083 Lee, W.R., Kirby, C.J., Debney, C.W. THE RELATION OF GERMLINE MOSAICISM TO SOMATIC MOSAICISM IN Drosophila. Genetics 55 (1967) 619-634.

A total of 72 fertile, yellow mosaic, attached-X females were produced by (x-)irradiating their paternal Y-chromosome ($sc^8\underline{Y}+Y\underline{B}^S$). Among the yellow mosaics the phenotype of the head and thorax was independent of the genotype of the germ line, and among 18 yellow mosaic females with mosaic germ lines there was no correlation between the proportion of mutant tissue in the germ line and somatic tissue. From the frequency of yellow imaginal discs that had lost the $\underline{y}^+$ marker and the frequencies of complete mutant, mosaic, and non-mutant germ lines, we estimated that an equivalent of 1.5 randomly mixed cleavage nuclei developed into the germ line, an estimate that was significantly less than the three to seven nuclei that usually penetrate the pole region of the embryo to become the primordial germ line. This discrepancy was explained on the basis of poor mixing in a viscous medium. The proportion of complete mutant to mosaic germ lines among mosaic embryos was calculated for mosaics that became fixed during 1st, 2nd or 3rd cleavage division. (Auth. summary)

1084 LeFever, H.M. STRUCTURE AND FUNCTION OF THE 3C1,2,3, REGION OF THE X-CHROMOSOME OF Drosophila melanogaster. Thesis. Texas Univ., Austin. 1966, 61p.

Historically, the region of the X-chromosome of D. melanogaster designated as 3C1,2,3 has been associated with the recessive eye mutant white (*w*). One of the primary objectives of this study was to determine if a fine structure analysis of the locus would uncover mutants concerned with only one basic metabolic process or if the structure analysis would uncover mutants concerned with diverse metabolic processes. Another objective was to establish the specific cytological limits of the white locus and to determine what other genetic traits, if any, can be localized to the 3C1,2,3 region. The region in question was screened, by the use of X-chromosome deficiencies, for all mutations induced by x-ray. The mutants recovered were balanced and then subjected to further genetic analysis. Four x-ray lethals were obtained which die when screened against a 3C1 deficiency. The results of a complementation analysis show that two of the lethals are non-complementary, while all others complement in combination with each other. Recombination analysis of the lethals established their spatial relationship to one another and indicated that the relationship of the 3C1 lethals to the white locus was one of close proximity, but without overlap regarding location. Three white mutants were recovered and were analysed with respect to their location in the locus and their relationship to the recessive eye mutant zeste. The mutant $\underline{w}^{crr}$ was found to possibly be isolocal to the white locus mutant $\underline{w}^{8wx}$ and a non-suppressor of zeste. The mutant $\underline{w}^{65a\,25}$ was a non-suppressor of zeste and located between the mutants $\underline{w}^a$ and $\underline{w}^{crr}$. The 3rd mutant $\underline{sp}\text{-}\underline{w}^1$ was found to be a true allele of the mutant $\underline{sp}\text{-}\underline{w}^1$. A mutant designated as 11G3 was reported in the literature to be located in 3C1 and act as a dominant suppressor of zeste. Analysis of this

mutant in this study indicated that the mutant 11G3 is located in or near the zeste locus (3A3). Two white lethals were analysed in this study. Analysis indicated that the lethal associated with one of the mutants occurs not in the white region but elsewhere in the X-chromosome. The 2nd white lethal was lethal because of a loss of 3C1 and was shown to act as a zeste suppressor. The results of this study indicate that the white locus is located definitely in 3C2 and possibly in 3C3, but not in 3C1. The white locus is a region concerned only with the process of eye pigment production and does not exhibit pleiotrophy. (Auth.)

1085 Lefevre, G., Jr. MUTATION FREQUENCIES DETECTED FOLLOWING IRRADIATION OF VIRGIN AND INSEMINATED Drosophila melanogaster FEMALES. Genetics 53 (1966) 137-143.

Sex-linked recessive lethal mutation frequencies were detected at successive intervals after irradiation with 4000 R of 3-d-old females, which were then mated with nonirradiated males. The mutation frequencies detected were compared with those obtained in parallel experiments in which irradiated females were mated with males that were separately exposed to the same dose of radiation, and with those detected following the irradiation of inseminated females. The irradiation of both paternal and maternal genomes, rather than only the maternal genome, results in a highly significant reduction in the frequency of mutations detected among eggs laid during the first 4 d after irradiation. Among eggs laid later, a small, but insignificant, reduction in frequency of mutations is detected when both genomes are irradiated. The suggestion is made that interaction between the two genomes, when both have been irradiated, leads to the elimination of a proportion of mutants induced in relatively mature germ cells. Since a similar loss of mutants does not occur following the irradiation of immature female germ cells, it is further suggested that mutants associated with chromosomal aberrations are preferentially eliminated by interaction of the two irradiated genomes. (Auth.)

1086 Matsudaira, Y., Ito, T., Yamasaki, T., Ishizaka, S., Domon, M. ON THE RELATIONSHIP BETWEEN THE FREQUENCY OF TWO TYPES OF MUTATION AND SOFT x-RAY DOSES IN Drosophila. Mutation Res. 4 (1967) 469-472.

The dose frequency relationship for two types of mutation, fractional- and whole-body, was obtained using soft x-rays on D. melanogaster. At low doses (e.g., 400 R-1440 R) more fractionals were induced than whole-body changes, whereas at high doses (e.g., 3000 R) the reverse relationship was observed. These results are in agreement with those of other investigations involving Drosophila and yeast. The origin of these mutations is discussed in relation to the strandedness of the DNA molecule of the gene. (Auth.)

1087 Meyer-Döring, H. NEUE FORSCHUNG ÜBER DIE MUTATIONSAUSLÖSUNG DURCH STRAHLEN. (Recent research on mutations induced by radiation.) Naturw. Rdsch., Stuttg. 13 (1960) 23-24. (In German)

Radiation experiments are reported on man, Drosophila, and mouse. Acute and chronic γ- and x-irradiation was used and analysed for mutagenic effects. In contrast to majority opinion it was found that a single (acute) dose produced a higher mutagenic effect than a fractionated dose (same total amount). The experimental results cannot just be simply extrapolated to apply to man.

1088 Moens, P.B. SEGREGATION OF TRITIUM-LABELED DNA AT MEIOSIS IN Chorthippus. Chromosoma 19 (1966) 277-285.

A technique is described which gives well-defined label on meiotic chromosomes which incorporated ^{3}H-thymidine two or more mitotic cycles prior to meiosis. Males of Chorthippus longicornis were injected with three doses of 0.0025 ml of ^{3}H-thymidine (1 mCi/ml, specific activity 6000 mCi/mM), given at 3-h intervals. The distribution of label on meiotic chromosomes can be used to determine in which mitotic cycles label was incorporated. It is concluded that sister chromatid exchanges are common prior to meiosis, and that chiasmata do not show crossing-over of labelled material to be expected if the chiasmata are the result of breakage and rejoining or if chiasmata and crossovers are not related.

1089 Mole, R.H. DOSE RATE AND TIME FACTOR. p. 18-33 of "Radiation Effects in Physics, Chemistry and Biology". Amsterdam, North-Holland Publishing Co. 1963.

Nine papers presented at the Second International Congress of Radiation Research are summarized. The work covered deals with x- and γ-radiation and with several different biological systems, including Drosophila eggs and silkworm larvae. In general it is concluded that changes in instantaneous dose rate from 1 rad/sec up to 10^5 rad/sec produce surprisingly little change in effect. On the other hand, the demonstration of even a relatively small change in mutation rate with variation in exposure time confirms current ideas that genetic mutation is not the instantaneous, permanent, and invariant response postulated by classical theory. Experiments on recovery from radiation and possible mechanisms of recovery are discussed briefly. (From NSA 17: 1963, 25019)

1090 Moriwaki, D., Tobari, I., Ohba, S., Kitagawa, O., Tobari, Y.N., Ikeda, H. A SHIFT OF SEX-RATIO IN THE PROGENY FROM IRRADIATED MALES IN Drosophila melanogaster. Idengaku Zasshi (Jap. J. Genet.) 42 (1967) 23-38.

Sex ratio changes in the progeny from males x-irradiated with doses up to 3 kR at different germ cell stages in D. melanogaster were investigated. The sex ratio (female/male) fell to the lowest level when the progeny developed from males mated 6-8 d after irradiation, and returned to the control level in the progeny from males mated at 14-16 d. The sex ratio decreased with increasing dose. Nonirradiated younger males produced more male than female offspring, a tendency that decreased with age. The sex ratio shift changed according to the frequency changes of both induced dominant lethals and elimination of sex chromosomes, showing a negative correlation, and all the frequencies coincidentally reached a peak on the 7th-8th day after irradiation. The stage-frequency relation for the sex chromosome elimination was fundamentally the same as that for the dominant lethals, suggesting that the two phenomena probably occur through the same mechanism. The highest sterility was found from the 6th to the 8th day post-irradiation. The results suggested that sperm utilised during these days represented cells irradiated during the meiotic stages. The proportion of X-chromosome elimination (S_e) and X-chromosome dominant lethals (S_x) to the total shift of the sex ratio (S) was estimated in each of the three different germ cell stages, i.e., postmeiosis, meiosis, and premeiosis. For the present data, the contribution of S_e and S_x to S was nearly the same at the meiotic stages, while at the other stages S_x played a greater role than S_e. (NSA 22: 1968, 15102)

1091 Murakami, A., Kondo, S., Tazima, Y. ENHANCING EFFECT OF FRACTIONATED IRRADIATION WITH 14 MeV NEUTRONS ON THE INDUCTION OF VISIBLE RECESSIVE MUTATIONS IN SILKWORM GONIA. Rep. natn. Inst. Genet., Misima 16 (1966) 109.

Earlier results obtained with low LET radiations (Tazima) had shown that the induced mutation rates were ~2-2.5 times higher in the dose fractionation group than in the single exposure group, for both spermatogonia and oogonia, when irradiation occurred around the stage of hatching. The present authors confirm that a similar enhancing effect of fractionation was also observable with 14 MeV neutron irradiation. Larvae of the wild type C108 were exposed to 14 MeV neutrons 1-3 d after hatching. A total of 1000 rad (500+500) were administered 10-12 h apart, at 0.8 rad/min. The enhancing effect of dose fractionation was more marked for spermatogonia than oogonia, the mutation frequencies were ~2 times higher than for single exposure. The highest enhancing effect was observed in spermatogonia when the 2nd dose was given 36 h after initial exposure, in contrast to the 18 h for x- and γ-rays. This delay of 18 h in the manifestation of the peak effect may be due to the fact that neutrons have a higher efficiency in affecting cell division than x- or γ-rays.

1092 Nakao, Y., Yamaguchi, E., Machida, I. MUTAGENIC EFFECTS OF MASSIVE ACUTE x-IRRADIATION IN Drosophila melanogaster. p. 61-62 of "Annual Report 1964". NIRS-4, National Inst. of Radiological Sciences, Chiba (Japan). Dec. 1965, 94p.

The existence of a linear relationship between mutagenic effects and dosage was tested for very high doses of x-rays and confirmed even at 10 kR. Doses of 5, 7.5, and 10 kR were used in the experiments. No parallelism between mutation frequency and sterility was observed for the acute high doses tested. Linearity for mutation frequency and x-ray dose, however, was observed even at 10 kR.

1093 Nakao, Y., Yamaguchi, E., Machida, I. COMPARISONS OF MUTAGENIC AND CELL-KILLING EFFECTS OF RADIATION IN THE SILKWORM. p. 62-63 of "Annual Report 1964". NIRS-4, National Inst. of Radiological Sciences, Chiba (Japan). Dec. 1965, 94p.

The specific locus method involving eye colour mutants in Bombyx mori was used. Pink eye (pe) and red eye (re) which are located on chromosome V at 0.0 and 31.7, respectively, were the markers.

Data are tabulated on visible mutation frequency and the number of eggs laid, their hatchability, and the percentage of dead eggs in early development. Data are based on female moths exposed to 2 kR in 0 at 400 R x-rays/min, and mated to double recessive pere/pere males. Only by a comparison with the percentage of dead eggs (at the unpigmented egg stage, which includes unfertilized eggs and fertilized eggs which die very early on) could a small significant difference be detected between groups set up according to number of eggs (<400>).

1094 National Inst. of Genetics, Mishima (Japan). ANNUAL REPORT NO.15 [ON GENETICS], 1964. NP-15975. 1965, 166p.

Data are summarized from genetic studies on animals, bacteria, higher plants, and human populations. Emphasis was also placed, amongst many others, on studies on Drosophila and silkworms. Data are included from studies on the mechanisms of chromosomal abnormalities induced by chemical mutagens and γ, x, or neutron radiations and related biochemical and cytological studies. A list is included of 86 publications for 1964.

1095 National Inst. of Radiological Sciences, Chiba (Japan). BIOLOGICAL STUDIES: GENETICS. p. 58-69 of "Annual Report 1964". NIRS-4. Dec. 1965, 94p.

The mutagenic effects of massive acute x-radiation doses in Drosophila melanogaster; a comparison of the mutagenic and lethal effects of x-radiation in silkworms; the effects of penicillin on x-radio-induced mutations in D. melanogaster; the effects of temperature on the frequencies of deleterious genes in a population of D. melanogaster; and the genetic effects of x-radiation in a population of D. melanogaster are among the studies described.

1096 Olvera, O. ESTUDIO DE LA FRECUENCIA DE MUTACIONES LETALES LIGADAS AL SEXO ESPONTANEAS E INDUCIDAS POR RAYOS X DURANTE LA ESPERMATOGENESIS. (Study of spontaneous and x-ray induced sex-linked lethals in spermatogenesis.) Thesis 1963. (In Spanish). Mexico?

1097 Plaine, H.L., Aubele, S.M. OCCURENCE OF THE ERUPT EFFECT IN THE Su-er tu bw; er^+ $Su\text{-}tu^+$ STRAIN OF D. melanogaster. Drosoph. Inf. Serv. 40 (1965) 56.

Three series of eggs and larvae of the Su-er tu bw; er^+ $Su\text{-}tu^+$ strain were collected over a 24-h period on the surface of cornmeal-dextrose media and exposed to x-irradiation at ±12 h of age. The disks of media containing irradiated eggs and larvae were placed on the surface of the same type of media and incubated at 25±1°C. Eyes of adult flies were scored upon emergence as extreme erupt, weak erupt, or normal. Evidence of the phenotype characteristic of extreme erupt was found consistently in all of the irradiated series, while all series subjected to x-irradiation differed significantly from the non-irradiated controls of the same strain. (From DIS)

1098 Puro, J. REPORT ON NEW MUTANTS. Drosoph. Inf. Serv. 39 (1964) 64-65.

Four Drosophila mutants are described that were produced by x-irradiation of wild type male flies. Several other spontaneous mutants are also described. (NSA 21: 1967, 22708)

1099 Rinehart, R.R. x-RAY INDUCED CHANGES IN Drosophila GERM CELLS. Three-Year Comprehensive Report, September 1, 1964-August 31, 1967. SAN-590-2, San Diego State Coll., Calif. 1967, 62p.

The effects of exposure, fractionation, and He post-treatment on x-ray induced mutations in D. melanogaster stage 7 oocytes were investigated. The effects of exposure to O_2 and He on x-ray induced dominant lethality and detachment frequencies in oogenic stages of females, and on x-ray induced dominant and sex-linked recessive lethality, translocation and non-disjunction frequencies in spermatogenic stages of males were also studied. Several general observations are discussed concerning causes of differential radiosensitivities in oogenic stages. The possibility for mutagenicity of irradiated Drosophila food and food supplements has been investigated intensively. It is concluded that (1) irradiated Drosophila medium is mutagenic; (2) medium supplemented with DNA or autoclaved sucrose is mutagenic, whether irradiated or not; (3) irradiated or non-irradiated non-autoclaved sucrose is not mutagenic; and (4) aging the food or food supplements does not significantly alter the mutation frequencies. No conclusions have been reached on the effects of culturing flies on irradiated and non-irradiated yeast.

1100 Ross, M.H., Cochran, D.G. GENETIC VARIABILITY IN THE GERMAN COCKROACH. I. ADDITIONAL GENETIC DATA AND THE ESTABLISHMENT OF TENTATIVE LINKAGE GROUPS. J. Hered. 57, 6 (1967) 221-226.

Five additional mutants of Blattella germanica (L.) are reported, four of the new mutants having been isolated from strains exposed to ionizing radiation and subsequently inbred. Detailed morphological descriptions as well as genetic data are presented for each trait. In addition, the results of certain linkage tests are included for these new traits as well as for those previously described. The first instances of linkage between visible markers are reported, and tentative linkage groups are proposed.

1101 Saksonov, P.P., Antipov, V.V., Shashkov, V.S., Razgovorov, B.L., Murin, G.F., Morozov, V.S. ON THE BIOLOGICAL EFFECT OF HIGH-ENERGY PROTONS. "14th Congr. internation. Astronaut, Paris, France. 1963". Polish Scientific Publishers, Warsaw, Poland. 1965.

Protons make up 85% of the primary cosmic rays. The harmful effects of 660 and 120 MeV protons was studied, and the radioprotection afforded by cystamine, serotonine, etc. in mouse and rat. The effects of protons on flies were also investigated.

1102 Shilenko, B.V. HETEROZYGOUS EFFECT OF MUTATIONS INDUCED IN THE SECOND CHROMOSOME OF Drosophila melanogaster. Genetika No.4 (1965) 109-114.

The effects of irradiation on the II-chromosome of an isogenous line of Drosophila were determined in accordance with the relative viability of individuals of the wild genotype in the F_2 cultures. There is evidence of the independence of viability from the competition. Irradiation of the chromosome did not affect the rate of heterozygotes development. (NSA 20: 1966, 22669)

1103 Smith, T.L. MUTANT TRAITS OF THE LARVAL AND PUPAL STADIA OF THE WAX MOTH. J. Hered. 58, 4 (1967) 179-184.

Larval and pupal variants were detected in stocks of Galleria mellonella that were being treated with ionizing radiations. The variants were isolated and upon eclosion as adults bred to their sibs. To date, 8 of 53 larval variants and 6 of 64 pupal variants have proved true mutations. The mutant effects have involved variations in the presence or absence of normal setae and the shapes and appearances of normal sclerites. The mutant traits are described and illustrated. A ^{60}Co-source was used. The dose administered was ~2000 R and was applied to virgin males ~1 d after eclosion. The treated males were in all cases mated to virgin females. The variant larvae and pupae showed up on the 2nd, 3rd, and subsequent generations of brother-sister matings of the treated male progenitors. The hereditary variants are interpreted as unit factor or point mutations.

1104 Speicher, B.R., Speicher, K.G., Roberts, F.L. GENETIC SEGREGATION IN THE UNISEXUAL WASP Devorgilla. Genetics 52 (1965) 1035-1041. And also ORNL-P-1330, Oak Ridge National Lab., Tenn.

The ichneumonid wasp Devorgilla reproduces by female parthenogenesis. Egg diploidy is retained by an abortive 1st maturation, where the separating anaphase dyads return to a common 2nd metaphase. One polar nucleus is then eliminated, so that two chromatids of each original tetrad are retained in the egg and two are discarded. The segregation of x-ray-induced recessive lethals was studied by counting the inviable eggs from heterozygous females. One lethal behaved as a point mutation and produced 12.77% homozygous recessive (lethal) eggs. Homozygous normal females also appeared in an approximately equal proportion. The frequency of homozygosis of each gene, being less than 16.67%, indicates that the centromeres involved separate reductionally at the first meiotic division and equationally at the second. The amount of detectable crossing over between the locus and the centromere is 25.53%. The actual map distance should be between 25.5 and a calculated 48.5 units. A 2nd lethal mutation produced 35.77% inviable eggs and only 2.78% homozygous normal females. The disparity between these two classes, and the high total inviability, suggest the presence of a chromosome aberration. (Auth.)

1105 Stromnaes, Ø., Kvelland, I. MUTATION FREQUENCIES IN SUCCESSIVE SPERM EJACULATES OF x-RAYED Drosophila melanogaster MALES. Genetics 50, 3 (1964) 337-349.

Four groups of unmated wild-type Oslo males were irradiated with 3000 R of x-rays when the males were 0-2 h, 12, 24 or 72 h of age. After irradiation the males were permitted to mate ad libitum

for 12 h, which was followed by a 12-h period without females, and again a 12-h mating period. All matings were observed and recorded, and the offspring from each individual mating were examined for the induction of Minutes, recessive sex-linked lethals, and translocations. An age effect is reflected in the mutation frequency of the sperm ejaculated during the 1st mating period, but not during the 2nd mating period. The induced-mutation frequencies observed in the 1st mating period were always higher than the frequencies induced in the sperm available in the 2nd mating period. The difference in induced mutation frequency between the two mating periods is ascribed partly to recovery and partly to differential sensitivity. (Auth.)

1106 Stromnaes, O., Kvelland, I. RADIOSENSITIVITY OF SPERM EJACULATED WITHIN 12 HOURS AFTER IRRADIATION. Drosoph. Inf. Serv. 40 (1965) 77.

Unmated D. melanogaster males from an Oslo wild-type stock were irradiated with 3000 R of x-rays when the males were either 12, 24 or 72 h old, and then mated individually to virgin M5 (Muller-5) females. All matings were observed and recorded. Copulating females were immediately isolated and after impregnation transferred to egg laying tubes. Thus, the frequency can be calculated of sex-linked recessive lethals in individual sperm ejaculates. Analysis of the tabulated data indicate that the frequency of sex-linked lethals increase with age of males at time of irradiation, in agreement with previous findings. All age groups of males can be seen to have a lower frequency of lethals in their 2nd ejaculate than in the 1st ejaculate. The data are not consistent in the 3rd mating for the three age groups of males. The 24-h-old males (Series 24 A) exhibit a further lowering in the frequency of lethals from the two previous matings: while the younger as well as the older males (Series 12 A and 72 A) have a higher frequency of lethals in their 3rd ejaculate than in their 2nd ejaculate. The data for 12- and 24-h-old males (Series 12 A and 24 A) are in agreement with previous findings, while we have no data directly compatible with those obtained in Series 72 A. A preliminary examination of the data suggests that for the youngest age group of males (Series 12 A) the frequency of lethals in the 1st ejaculate depends on the time after irradiation. Thus, 1st ejaculates available for fertilization the first 8 h after irradiation exhibit a higher frequency of lethals than do 1st ejaculates available for fertilization 8-12 h after irradiation. (From auth.)

1107 Tanaka, Y., Goto, F. EXPERIMENTAL STUDIES ON THE CHARACTERISTICS OF VARIOUS GENES IN THE SILKWORM. (No. 1) Sanshi Kagaku Kenkyusho Iho No. 14 (1966) 20-25. (In Japanese) (Reports of the Silk Science Research Institute)

In the strain in which the hereditary effect has been diminished after a series of close relative crossings and selections, it is very important to know whether it is possible to increase the selectivity by increasing the hereditary variations due to a certain mutation-inducing agent. However, most of the useful characters are affected adversely by application of radiations, and in addition, the non-hereditary variations that occur tend to confuse the interpretation of the results. In the present study, therefore, by way of the basic research for the future breeding of silkworms two kinds of readily discernible maculae not connected with the mutagenic effect of radiation were used. Silkworm eggs were x-irradiated at doses of 500-1000 R 1 h after laying, and the maculae distributions that subsequently occurred in the third and fourth generations were compared with those of the control group. No effect was observed in the range of experiments performed; results agreed with those obtained for chickens. (NSA of Japan)

1108 Tazima, Y., Sado, T. POST-IRRADIATION MODIFICATION AND MECHANISM OF REVERSE DOSE-RATE EFFECT ON MUTATION INDUCTION IN SILKWORM GONIA. Rep. natn. Inst. Genet., Misima No. 17 (1966) 90.

For abstract, see 974.

1109 Tikhomirova, M.M. COMPARATIVE STUDY OF RADIOSENSITIVITY OF DIFFERENT Drosophila STRAINS. Genetika No. 3 (1966) 93-97. (In Russian)

The frequency of breakage of X-chromosomes, estimated by appearance of exceptional males (of the XÜ type), was used as an indicator of radiosensitivity of a Drosophila line. Irradiation was effected by means of x-rays of the same regime at a dose of 3000 R. Comparative analysis of three lines showed that one of them is relatively radiosensitive while the other two lines are radioresistant. Consecutive action of x-rays and high temperature caused increase of frequency of appearance of exceptional males whereas radiosensitivity of the lines became levelled. Levelling of radiosensitivity

was due to a varying manifestation of the after-effect in different lines. Discussion is presented on whether the mechanism of determining radiosensitivity of Drosophila lines depends on correlation of real and potential changes taking place at the moment of irradiation and realization grade of the latter. (Auth.)

1110 Tupitsyna, E.M. STUDIES ON THE NATURE OF x-RAY-INDUCED SOMATIC MOSAICISM IN HETEROZYGOTE YELLOW AND SINGED FEMALES OF Drosophila melanogaster. Genetika No.1 (1965) 123-129. (In Russian)

The frequency of body spots (single and double) in heterozygote y and sn D. melanogaster females was investigated. In the control all spots, both single and double, are probably the result of crossing-over in the region between gene sn and the centromere. Single spots are primarily the result of the incomplete development of the complementary spot. The relationship between the manifestation of the character as a double spot and the time of its appearance is the same as the relationship between the size of a cell population and the number of cell divisions (for a given period). It is concluded that both in the experiment and the control most of the spots, including single ones, arise as a result of crossing-over. (Auth.)

1111 VandeHey, R.C., Craig, G.B., Jr. GENETIC VARIABILITY IN Aedes aegypti (DIPTERA: CULICIDAE). II. MUTATIONS CAUSING STRUCTURAL MODIFICATIONS. Ann. ent. Soc. Am. 55 (1962) 58-69.

Mutations were isolated in the course of an analysis of variability in lab mosquito populations. Some mutations were obtained from stocks that were irradiated. Males about 48 h postemergence were given doses of 2000-4000 R with either x-rays or γ-rays from a ^{60}Co source. These males were crossed to unirradiated females and their progeny were again crossed to unirradiated individuals. The F_2 progeny from the latter cross was examined for modifications. Detailed descriptions are given of the mutants. Most of the mutants showed reduced penetrance and variable expressivity, which made determination of the mode of inheritance of these factors difficult. In many cases, selection over several generations improved the penetrance of the structural factors. However, lines with 100% penetrance were developed in only a few cases. (NSA 21: 1967, 10834)

1112 Voelker, R.A. FURTHER STUDIES ON THE GENETICS OF Drosophila affinis. Genetics 56, 3 Pt.2 (1967) 593.* Presented at "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

Miller and Stone (1962) reported a Nebraska strain of D. affinis to lack a Y-chromosome. It was wondered whether X0 males induced by X-chromosome non-disjunction would also be fertile in this species. - To obtain sex-linked mutants for detecting patroclinous males, wild-type males (Arkansas strains) were irradiated with 2500 R of x-rays and pair mated to wild-type females, and male progeny of F_1 pair matings were checked for mutants. The following mutants were recovered: X-linked-blistered, bristle, Notch (associated with a C-D translocation), Polychaetoid, and roughoid: autosomal-crumpled and Cut. - To recover patroclinous males, recently emerged (0-6 d) virgin females were irradiated (2000-3000 R) and mated to males differing as to sex-linked traits: wild-type females to Polychaetoid or bristle males, bristle females to wild-type males. Male offspring were patroclinous with a frequency of 4/7995. Such males were mated to their sisters. They were determined to be X0 due to non-disjunction by establishing that (1) their male offspring lacked a Y-chromosome and (2) their brothers possessed a Y-chromosome. Thus, induced X0 males, as well as X0 male offspring of wild-caught females, are fertile in this species. (Abstr.)

* Read by title only.

1113 Wagoner, D.E. TRANSLOCATION INDUCTION AND ANALYSIS IN THE HOUSE FLY, Musca domestica L. Genetics 56, 3 Pt.2 (1967) 594. Presented at "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

Over 150 translocations have been induced with x-rays in the housefly and have been analysed for the following information from crosses of heterozygous translocation-bearing males (no crossing over) to appropriately marked females: (1) Sex ratio of progeny; (2) ratio of translocation to non-translocation bearing progeny; and (3) egg hatchability. The most promising stocks are being selected for laboratory studies on the population-depressing effects of translocations. The tests include observations of heterozygous and homozygous double, triple, and quadruple reciprocal

translocations alone and in various combinations with one another, and one after the other in population cages. - Cytological study has been completed of enough of the induced translocations to assign the five linkage groups previously reported for the housefly (Hiroyoshi, J. econ. Entomol. 53: 1960, 985; Milani, Atti Assoc. Genet. Ital. 6: 1961, 427; Tsukamoto, Baba, and Hiraga, Japan. J. Genet. 36: 1961, 168) to their corresponding autosomes (no sex-linked markers have been found, 2n=12, male is heterogametic). The analysis shows the R1 marker and its associated linkage group located on chromosome I (longest pair), the car marker and its linkage group on chromosome II, and bwb marker and its linkage group on chromosome III, the ye marker and its linkage group on chromosome IV, and the ocra marker and its linkage group on chromosome V (shortest pair). X and Y represent the sex chromosomes. They appear to be entirely heterochromatic, and no representative mutants have been found thus far. (Abstr.)

1114 Whiting, A.R. THE BIOLOGY OF THE PARASITIC WASP Mormoniella vitripennis (=Nasonia brevicornis) (Walker). Q. Rev. Biol. 42, 3 (1967) 334-406. *

The biology, economic importance, physiology, ecology, cytology, and genetics of the wasp are reviewed, and its use and value in research are also considered. Normally Mormoniella is an ectoparasite, and uses the pupae of larger Diptera as hosts; at 28°C a generation is completed in 10 d. The species is world-wide in its distribution, and may be found wherever hosts are available. Females are inefficient flyers, and males cannot fly. In genetical research, largely using Sarcophaga pupae as hosts, both spontaneous and radiation-induced mutants have been studied. The R locus, described in "orthodox" genetic terms as a chromonemal region is marked by eye colour mutants as well as many other genes, all of which show complete linkage and govern various deleterious traits, including male and female sterility and reduced viability at various stages of the life cycle. Incompatibility in reciprocal crosses is reported to be governed by cytoplasmic factors. The haploid males have five chromosomes but little is known about linkage relations or the method of sex determination at present. Dose-action curves by exposing eggs to x-rays and to neutrons, and of treating sperm with x-rays, is reported. (From auth.)

* Radiation work is discussed on p. 372 and 391-398.

1115 Whiting, P.W. "BLACK" EYE COLORS OF Mormoniella. Genetics 54 (1966) 639-655. And also as ORNL-P-82, Oak Ridge National Lab., Tenn.

Eye-colour mutations in Mormoniella may be grouped as "bright" and "black", the former occurring much more frequently. Of 13 separate black mutations, eight were "eb (ebony) black" and five were "bk (black) black". The first "black" mutant occurred in 1952 as a lavender-eyed male among sons of an x-rayed red-eyed (R-locus O-factor dahlia-GF) female. Three blacks, "bk-352, -386 and -394", were obtained later (Caspari) after x-raying da-GF females. Combinations were made with R-locus dahlia, da, scarlet, st, and orange, or. da eb is black phenotypically, da bk lavender; st eb is scarlet, st bk white; or eb and or bk are both white. Because some of the ebonies and blacks are difficult or impossible to distinguish from wild type by inspection, the white combinations were used in determining homology, white offspring from crosses indicating homology, colored indicating nonhomology. The eight ebonies proved homologous. The five bk blacks included two pairs of alleles and a third gene linked with R giving 20.1% crossovers. F_2 males from crosses of blacks and R-locus genes and between nonhomologous blacks gave data indicating linked viability depressors, linkage between a black and R, and linkage of black loci (repulsion phase) resulting in excess of whites. Several of these linkages are probably spurious owing to chromosomal irregularities. Deficiency of whites from some crosses may be due to reduced viability of the double recessives. One of the ebony genes depresses viability to 50% of normal, and a bk-black gene depresses viability to less than 90%. Differences in intensity of black between different stocks may be caused by the state of the black genes themselves, some being weak enough to give a wild phenotype, or there may be suppressors at other loci. Gene formulae for the black genes may be expressed in terms of factor states as in the R alleles. (Auth.)

1116 Zambruni, L. THE RESPONSE OF THE BROWN SPOTS CHARACTER FOR Drosophila melanogaster TO TREATMENT WITH x-RAYS. Rc. Ist. lomb. Sci. Lett. B 97 (1963) 3-18. (In Italian)

Larvae, pupae, and adults of the two stocks carrying the brown spots character (bsp) of D. melanogaster (wild Aspra 52 and a stock derived from this, isogenic for the II-chromosome) were irradiated.

The data reported demonstrate clearly that the character under examination is sensitive to ionizing radiation during the whole period of development of the individual, from the young larva to the newly emerged adult. In the isogenic stock, x-rays caused a decrease in the frequency of the character manifestation in the individual treated as larvae. In the pupae, on the other hand, no particular effect was noted. In adults, 24 h after emergence from the pupal case, irradiation caused an increase in the frequency of the spots. In the wild stock a response was obtained that was similar to that observed in the isogenic one, but was more marked. The decrease obtained both in the larvae and in the pupae was much more marked, as was the increase in the adults. A complex mechanism, therefore, appears to govern the manifestation of the bsp character. As to its nature, it was possible to formulate several hypotheses, among which the present data do not allow any preference. The action of x-rays, however, both in larval and pupal stage, seems to tend to inhibit the spots, presumably as a consequence of the damage caused to the whole organism and in particular to undifferentiated cells. In the adult stage, however, the action of radiation seems to facilitate the production of the spots, probably on the basis of an increase in enzymatic activities. (NSA 20: 1966, 42945)

See also:

33 Distribution of lethals induced by tritiated DNA precursors in Drosophila melanogaster. (Kaplan, W.D. et al., 1966)

34 Stability of Drosophila chromosomes to radioactive decay of incorporated phosphorus-32. (Lee, W.R. et al., 1966)

35 The production of mosaics by incorporation of P^{32} into DNA of Drosophila melanogaster spermatozoa. (Lee, W.R. et al., 1967)

36 Mutations produced by transmutation of phosphorus-32 to sulfur-32 within Drosophila DNA. (Lee, W.R., 1967)

916 Some unusual topics in radiation biology. (Zimmer, K.G., 1966)

921 Cytogenetic analysis of lethal mutation induced during different stages of spermatogenesis in Drosophila. (Khashim-Akhmed, M.S., 1965)

928 Cytological evaluation of dose-rate effects of radiation on mutation frequency of silkworm gonia. I. Kinetics of proliferation and killing of spermatogonia during chronic irradiation. (Sado, T., 1966)

932 Further evidence demonstrating germinal selection in early premeiotic germ cells of Drosophila males. (Abrahamson, S. et al., 1966)

940 Radiomutability and heterogeneity of male germ cells of Drosophila before, during, and after meiosis. (Frity-Niggli, H., 1966)

943 Mutation rates at specific autosomal loci in different species of Drosophila. (Hannah-Alava, A., 1966)

944 Cytogenetic analysis of lethal mutations induced at various stages of spermatogenesis. (Hashim- Ahmed, M.S., 1965)

949 The relative mutagenic effectiveness of fast neutrons and x-rays in pre- and post-meiotic germ cells of Drosophila melanogaster. (Lamb, M.J. et al., 1967)

950 Molecular and radiation genetics. Annual Report 1965. (Leiden Rijksuniversiteit Netherlands, 1966)

957 Annual Report of the National Institute of Genetics, No.16, 1965. (National Inst. of Genetics, Mishima, Japan, 1966)

963 Techniques for studying the effects of radiation on meiosis and related processes in mosquitoes with particular reference to Aedes aegypti. (Rai, K.S., 1968)

964 Cytological evaluation of dose-rate effects of radiation on mutation frequency of silkworm gonia. II. Evidence of G_2 accumulation of primary spermatogonia after acute irradiation. (Sado, T. et al., 1966)

965 Dose-rate effect in the repair of radiation damage in spermatids of Drosophila melanogaster. (Sankaranarayanan, K., 1967)

974 Post-irradiation modification and a possible mechanism of the reverse dose-rate effect on mutation induction observed in silkworm gonia. (Tazima, Y. et al., 1966)

975 Changes in the mutation response of post-meiotic silkworm germ cells to γ-rays with the progressing spermiogenesis. (Tazima, Y., 1966)

980 Dependence of mutation frequency on the x-ray dosages in the sensitivity of pre-meiotic and post-meiotic stages of spermatogenesis. (Vatti, K.V., 1965)

982 Methods for radiation studies during oogenesis in Habrobracon juglandis (Ashmead). (Whiting, A.R. et al., 1968)

984 Induced mutations and lethality in Drosophila after x-irradiation of meiotic and post-meiotic stages of the egg. (Würgler, F.E., 1968)

985 Rates of autosomal recessive lethals after x-ray treatment of spermatogonia and spermatozoa in Drosophila melanogaster. (Ytterborn, K.H., 1967)

1021 Chromosome breakage and loss following alpha particle treatment of Drosophila. (Malich, C.W. et al., 1966)

1122 Genetic effects of chronic γ-radiation on Habrobracon sperm. (Borstel, R.C. von, et al., 1967)

1139 Sterility, chromosome breakage, x-ray-induced mutation rates and detected mutation frequencies in Drosophila melanogaster. (Lefevre, G., Jr., 1967)

1143 Mutation yield in a theoretical cell population of heterogeneous sensitivity to mutation induction and to killing. (Oftedal, P., 1966)

1150 x-Radiation induction of mutations in Habrobracon. (Smith, R.H. et al., 1966)

1176 Influence of 2,4-dinitrophenol (DNP) on mutation frequency in sperm cells and spermatids of Drosophila irradiated with gamma rays. (Abeleva, E.A., 1966)

1177 Normalizing effect of arginine on the relation between the ionizing radiation dose and the frequency of mutation generation in Drosophila spermatids. (Abeleva, E.A., 1966)

1178 Dimethyl sulfoxide treatment of Drosophila. (Alexander, M.L., 1966)

1180 Results of biological investigations conducted during flights of "Vostok" type vehicles with the participation of cosmonauts A.G. Nikolayev, P.R. Popovich, and V.F. Bykovskiy. (Antipov, V.V., 1966)

1181 Gamma radiation and heterosis in Aedes aegypti. (Asman, S.M. et al., 1967)

1182 Mutagenic effectiveness of known doses of gamma radiation in combination with weightlessness of Habrobracon. Summary Progress Report, February 17, 1964-June 30, 1966. (Borstel, R.C. von, 1967)

1183 Mutagenic effectiveness of known doses of gamma radiation in combination with weightlessness on Habrobracon. Quarterly Progress to the National Aeronautics and Space Administration, July 1-September 30, 1966. (Borstel, R.C. von, 1967)

1184 Effects of ecdysones on frequency and distribution of x-ray induced lethals in Drosophila melanogaster. (Burditt, W.J. et al., 1967)

1188 Fast neutron and x-ray irradiation of Drosophila melanogaster oogonia and oocytes. (Dickerman, R.C., 1967)

1189 Mutational response of Drosophila melanogaster oocytes and oogonia to x-ray and fast neutron irradiation. (Dickerman, R.C., 1967)

1190 "Research in Genetics to include: (1) The Direct and Indirect Effects of Radiations and their Modification on Genetic Systems, and (2) Population and Evolutionary Studies of Drosophila". (Elequin, F.T. et al., 1965)

1191 Modification of induced genetic damage in Drosophila melanogaster by oxygen and argon treatments between two doses of x-rays. (Elequin, F.T., 1966)

1195 Studies on the experimental population of Drosophila melanogaster raised on irradiated banana diet. (Hossain, M.M. et al., 1966)

1196 ibid (1967)

1197 An attempt to sensitize Drosophila chromosomes to x-irradiation after 5-bromodeoxyuridine incorporation into DNA. (Khan, A.H. et al., 1966)

1198 Occurrence of lethal mutations in the heterochromatinic region of Drosophila melanogaster X chromosome depending on preradiational development temperature. (Kogan, Z.M., 1966)

1199 RBE of fast neutrons to γ-rays for mutations in relation to repair mechanisms. (Kondo, S., 1965)

1201 Investigations on the influence of 5-bromouracildesoxyriboside (BUdR) on the radioinduced mutation rate in Drosophila melanogaster. (Magdon, E. et al., 1967)

1209 Effect of conjugate aromatic systems on heredity. I. Mutagenic and antimutagenic effect of certain indene compounds. (Mosse, I.B. et al., 1964)

1210 Effect of various compounds on spontaneous and γ-radiation-induced mutability of Drosophila melanogaster. (Mosse, I.B. et al., 1965)

1211 Modification of radiation-induced mutation frequencies by antibiotics in Drosophila melanogaster. (Mukherjee, R.M., 1966)

1212 The potentiating effect of sodium fluoride on the induction of mutations by x-rays in mature spermatozoa of Drosophila melanogaster. (Mukherjee, R.N., 1967)

1213 The effect of 5-bromodeoxyuridine (BUdR) on the frequency of 14 MeV fast neutron induced mutations in the gonial cells of the silkworm. (Murakami, A., 1966)

1214 The effect of pretreatment with maleic hydrazide of the mutation rate induced by gamma radiation in Drosophila melanogaster. (Nasrat, G.E., 1967)

1218 Thymidine teratogenesis and mutagenesis in Drosophila melanogaster. (Parkash, O., 1967)

1220 X-ray induced changes in Drosophila germ cells. Three-Year Comprehensive Report September 1, 1964- August 31, 1967. (Rinehart, R.R., 1967)

1221 Influence of helium posttreatments and exposure fractionation on x-ray induced dominant or sex-linked recessive lethality and X-chromosome loss in stage 7 oocytes of Drosophila melanogaster. (Rinehart, R.R., 1967)

1222 Mutation in Drosophila melanogaster cultured on irradiated whole food or food components. (Rinehart, R.R. et al., 1967)

1223 On the biological effects of high energy protons. (Saksonov, P.P. et al., 1965)

1225 The failure of irradiated DNA to produce mutation in Drosophila melanogaster. (Seecof, R. et al., 1966)

1226 Radiosensitization of Drosophila melanogaster by N-ethylmaleimide. (Sharma, R.P., 1966)

1227 Differential effect of penicillin on x-ray induced mutations in Drosophila melanogaster. (Shiomi, T., 1965)

1228 Effects of penicillin feeding on the frequency of x-ray induced mutation in Drosophila. (Shiomi, T., 1966)

1234 The contrasting effects of O_2 and N_2 in determining initial sensitivity and post-radiation recovery in Drosophila sperm and spermatids. (Sobels, F.H., 1964)

1235 Processes underlying repair and radiosensitivity in spermatozoa and spermatids of Drosophila. (Sobels, F.H., 1966)

1236 Repair of radiosensitivity phenomena in Drosophila males. (Sobels, F.H. et al., 1967)

1237 RBE values for genetic effects of 15 MeV neutrons in relation to stage sensitivity in Drosophila. (Sobels, F.H., 1967)

1238 Modification of γ-ray-induced mutation frequencies in the silkworm by post-treatment of spermatids and spermatozoa with nitrogen. (Tazima, Y. et al., 1966)

1241 Metabolic conditions before and after irradiation. (Thornley, M.J., 1963)

1242 Post-irradiation recovery in early spermatids and spermatocytes sampled from Drosophila pupae. (Watson, W.A.F., 1966)

1243 Post-radiation recovery in spermatids sampled from 24 hr. old pupae of Drosophila melanogaster. (Watson, W.A.F. et al., 1967)

1244 Post-radiation recovery in early spermatids sampled from Drosophila pupae. (Watson, W.A.F., 1967)

1245 Mechanisms of dose-rate effects: insights obtained from intensity and fractionation. (Wolff, S., 1965)

1250 Disproportionate amounts of genetic damage induced by ethylenimine and x-radiation treatments. (Alexander, M.L., 1966)

1253 A comparison by means of x-irradiation in air and in oxygen of the supressor-erupt systems in several strains of Drosophila melanogaster. (Aubele, A.M., 1967)

1255 Experience with high energy electron beam therapy. (Botstein, C. et al., 1965)

1260 Biological organization in relation to differential gene response to mutagens. (Fahmy, O.G. et al., 1965)

1261 The nature and distribution of the mutations induced by unirradiated and irradiated heterologous deoxyribonucleic acid in Drosophila melanogaster. (Fahmy, O.G. et al., 1966)

1262 Chemically induced viability mutants in D. melanogaster. (Friedman, L.D. et al., 1966)

1263 The action of radiation and other mutagenic agents 1. in inducing mutation in Drosophila females, and 2. in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, H.B., 1966)

1264 EMS and ICR- 100 induced chromosome 4 lethals in D. melanogaster. (Hochmann, B., 1967)

1269 Mechanism of mutation and inducing factors. (Landa, Z., 1966)

1270 Comparative mutagenic activity of some aromatic compounds with or without γ-irradiation. (Mosse, I.B. et al., 1965)

1271 Relative biological effectiveness of 14 MeV neutrons to gamma-rays for inducing mutations in mature sperm of the silkworm. (Murakami, A., 1966)

1273 Cytological analysis of formaldehyde induced chromosomal changes in Drosophila melanogaster. (Slizynska, H., 1957)

1274 Dominant and recessive lethal mutations induced by mitomycin C in Habrobracon oocytes and sperm. (Smith, R.H., 1967)

1276 Studies on the mutagenic action of formaldehyde in Drosophila. II. The production of mutations in females and the induction of crossing-over. (Sobels, F.H., 1956)

1278 Stock differences in x-ray mutational sensitivity pattern of Drosophila melanogaster. (Strømnaes, Ø., 1959)

1280 Temperature-sensitive mutations in Drosophila melanogaster. I. Relative frequencies among γ-ray and chemically induced sex-linked recessive lethals and semilethals. (Suzuki, D.T. et al., 1967)

1284 Investigations on the mutagenic effect of nitroso compounds. (Trams, A. et al., 1966)

1312 X-ray-induced mutability of polygenes controlling hatching time in Drosophila melanogaster. (Pulityer, J.F., 1966)

1360 Effect of x and γ radiation on the development of unmatched gypsy moths (Ocneria dispar L., Lymantriidae, Lepidoptera). (Kakhmanyuk, F.S. et al., 1967)

1367 Dependence of the somatic mutation spectrum of Ephestia kuehniella on the development stage of the irradiated animal. (Mueller, I. et al., 1966)

1390 Effect of gamma radiation on Trogoderma glabrum and Attagenus piceus. (Tilton, E.W. et al., 1966)

1395 Studies on the radiosensitivity of early embryonic stages of Drosophila melanogaster. (Würgler, F.E., 1964)

1397 Effects of gamma radiation on development of Dermicentor occidentalis (Ixodidae). (Ziad Al-ahmadi, A., 1967)

1419 Estimation of sensitivity of Drosophila melanogaster to radiation using a third-order rotable design. Three Year Comprehensive Report. (Ratty, F.J., 1966)

1422 Differential gerontomimetic effects of pupal x-irradiation on adult male and female house flies. (Rockstein, M. et al., 1966)

1452 Results of biological experiments carried out under conditions of flight in ships Vostok with participation of cosmonauts A.G. Nikolayev, P.R. Popovich, and V.F. Bykovsky. (Antipov, V.V. et al., 1964)

1453 Results of biological experiments carried out under conditions of "Vostok" flights and with the participation of cosmonauts A.G. Nikolayev, P.R. Popovich and V.F. Bykovsky. (Antipov, V. V., et al., 1965)

1489 Induced mutations in polygenic systems. (Aastveit, K., 1966)

1491 A study of the genetic processes in irradiated populations of Drosophila melanogaster. III. The fecundity and the concentration of lethal mutations. (Bileva, D.S., 1967)

1504 Effect of selection on whaxy: an autosomal dominant mutation in the screw-worm fly with recessive lethal effects. (LaChance, L.E., et al., 1965)

1507 The genetic structure of natural populations of Drosophila melanogaster. IV. Heterozygous effects of radiation-induced mutations of viability in various genetic backgrounds. (Mukai, T. et al., 1966)

1508 Genetics. (National Inst. of Radiological Sciences, Chiba, Japan., 1966)

1509 Recessive lethals in second chromosomes of Drosophila melanogaster with radiation histories. (Salceda, V.M., 1967)

1562 A. The IAEA laboratory at Vienna and Seibersdorf. Second Report. IV. Agriculture. B. Insect eradication and pest control. 5. Co-ordinated programme on insect eradication and sterile-male technique. (IAEA, Vienna, Austria, 1965)

2.1.6. Dominant Lethality. Sterility (See also 2.4.2.1.). Cell Killing

1117 Abdul Matin, A.S.M., Bhuiya, A.D., Khan, Z.A. ATTEMPT TO OBTAIN STERILITY OF MALE RICE Hispa THROUGH GAMMA RADIATION. p.155-156 of "Proceedings of the Agricultural Symposium. Dacca, Pakistan, 1966".

The adult male beetles were irradiated at various doses of γ-radiation at a fixed dose rate of 34.80 R/h and placed in cages with untreated females. Records were kept of egg production, hatch etc. When untreated virgin females were mated with irradiated males, the percentage of viable eggs decreased

with an increase in dose. The average egg hatch in the untreated controls was 71.49% whereas matings with male beetles exposed to 10000, 8000, 7000, 6000, and 5000 R showed averages of 1.4, 1.41, 9.3, 12.72, and 14.50% egg hatch respectively. (Auth.)

1118 Andreev, S.V., Martens, B.K., Malchanova, V.A., Saidan, L.N. RADIATION STERILIZATION IN CONTROLLING INSECT PESTS. Vest. sel'khoz. Nauki No. 1 (1967) n.p.

1119 Arroyo, M., Jiménez, A., Mellado, L., Caballero, F. APPLICACION DE ISOTOPOS RADIACTIVOS A LA INVESTIGACION DE METODOS SOBRE LUCHA CONTRA LAS PLAGAS. III. OBTENCION DE MACHOS ESTERILES DE Ceratitis capitata Wied., MEDIANTE LA IRRADIACION DE SUS PUPAS CON RAYOS GAMMA. (Application of radioactive isotopes to the investigation of methods for the biological control of pests. III. The obtaining of sterile males of C. capitata by irradiation of the pupae with γ-rays.) Bolm Patol. veg. Ent. agric. 28 (1965) 257-280. (In Spanish)

An account is given of experiments carried out in 1965 to obtain sterile adults by exposing the pupae to ^{137}Cs. When pupae 5 or 6 d old received doses of 10000 or 15000 rad γ-radiation, 68-86 and 4-40%, respectively, gave rise to active adults, as compared with 98% of those not irradiated. The adults thus obtained were crossed. With adults derived from pupae irradiated at 10000 rad, no eggs were laid by irradiated females confined with either irradiated or normal males. Normal females confined with irradiated males laid a reduced number of eggs, a small proportion of which hatched and developed normally. When adults derived from pupae treated at 15000 rad were paired, irradiated females laid no eggs when confined with normal males and normal females laid non-viable eggs when confined with irradiated males. A few eggs that developed normally appeared to have been laid by irradiated females confined with irradiated males, though this may be accounted for by experimental error. In all cases, adults derived from irradiated pupae died sooner than those from normal ones. All the adults from pupae irradiated when 5 d old at 15000 rad were dead within 15 d. In the remaining cases, 70-85% of the males and 50-77.5% of the females died within 15 d, as compared with 37.5 and 26% of normal males and females, respectively. All the irradiated individuals appeared more torpid, especially in the first few days, than normal ones, but this did not prevent them from pairing. In a further series of experiments, pupae were irradiated at 8000 or 10000 rad when 7 d old. At both rates, 89% of them gave rise to active adults. When these were crossed, no irradiated females oviposited and none of the eggs laid by normal females confined with irradiated males hatched. The mortality of adults derived from these irradiated pupae was lower during the first 15 d than that of adults in the previous series of tests, though mortality was still somewhat higher than that of normal adults. Pairing occurred normally, and in some cases the flies paired more than once. (RAE-A 55: 1967, ref. 254)

1120 Arroyo, M., Jiménez, A., Mellado, L., Caballero, F. APPLICACION DE ISOTOPES RADIACTIVOS A LA INVESTIGACION DE METODOS SOBRE LUCHA BIOLOGICA CONTRA LAS PLAGAS. IV. EFECTOS DE LA RADIACION GAMMA SOBRE Ceratitis capitata Wied., EN FUNCTION DEL FRACCIONAMIENTO DE LA DOSIS DE IRRADIACION. (Application of radioactive isotopes to the investigation of methods for the biological control of pests. IV. The effects of γ-radiation on C. capitata when the dose of irradiation is fractionated.) Bolm Patol. veg. Ent. agric. 28 (1965) 281-292. (In Spanish)

Results are given of tests carried out to investigate whether a fractionated dose of γ-radiation received by pupae of C. capitata would be less detrimental to the vitality of the resulting adults than a single dose, without impairing the degree of sterility obtained in the tests reported in the preceding paper. There, 7-d-old pupae had been irradiated at ≥8000 rad. It was found that no advantage was gained by irradiating the pupae when 6 d old at 5000 or 8000 rad and again when 7 d old at 5000 or 8000 rad, in any combination of these doses. (Essentially RAE-A 55: 1967, ref. 255)

1121 Bostel, R.C., von. THE THEORY OF RADIATION-INDUCED DOMINANT LETHALITY IN SPERM. p. 232 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy, 26 Jun.-2 Jul. 1966, 263p", Abstr. 921

Dominant lethality due to chromosome breakage and bridge formation results in early death of Drosophila and Habrobracon. Radiation-induced bridges can be formed in two ways: by terminal deletions and by dicentric translocations. Terminal deletions of chromosome limbs lead to attachment of the new ends together when a new chromosome is synthesised. A bridge is then formed during anaphase. Such bridges from terminal deletions arise from single events and the proportion

which escapes this fate is

$$S_1 = e^{-k_1 D} \quad (1)$$

where k_1 is the effective sensitivity and D is the dose of radiation. Dicentric translocations require that two chromosomes be broken and rejoin in such a way that two centromeres are present in one chromosome. We assume that there are a definite number of regions ("sites") in each nucleus where such translocations can occur. With this assumption it can be shown that the proportion which escapes this fate is

$$S_2 = [1 - (1 - e^{-k_2 D})^2]^m \quad (2)$$

where m is the number of sites. Multiplying equations (1) and (2) gives the proportion which escapes both fates:

$$S = S_1 \cdot S_2 \quad (3)$$

With the proper choice of parameters, equation (3) adequately describes the frequency of early deaths of embryos following fertilization of eggs by irradiated sperm. The frequency of dicentric translocations can be estimated from dominant lethal data by the use of equation (3). This frequency can be compared to the frequency of reciprocal translocations measured genetically. (Abstr.)

1122 Borstel, R.C., von, Smith, R.H., Whiting, A.R. GENETIC EFFECTS OF CHRONIC γ-RADIATION ON Habrobracon SPERM. Radiat. Res. 31, 3 (1967) 615. Abstr. Eb-8, at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Because of haploidy of the male, it is possible in Habrobracon to test the entire genome for dominant lethality, recessive lethality, inherited partial sterility (the majority being translocations), and visible mutations. In addition, the time of death from the lethal events can be accurately scored during the testing procedure. This genetic system was used to test the effects of chronic ^{85}Sr γ-radiation in comparison with acute x-radiation on Habrobracon sperm. The males were exposed to chronic γ-radiation over a 66-h period. For the acute irradiation studies, in one experiment the males were mated immediately, and in a second, after a 66-h delay. At the same dose levels the genetic effects did not differ appreciably. Further, a dose-action curve for genetic effects of the chronic γ-radiation over a range from 400 to 4000 R shows that 0.5 of the recessive lethals are embryonic and 0.5 are larval or pupal. A linear response for recessive lethals is obtained up to the highest dose given the sperm. At low doses, the inherited partial sterility increases approximately with the square of the dose; above 2000 R, the increase is less. (Abstr.)

1123 Buginsky, V.I. EFFECTIVENESS OF STERILIZATION OF THE MALLOW MOTH; IRRADIABILITY AT DIFFERENT STAGES OF DEVELOPMENT, AND CERTAIN FEATURES OF MATING AND EGG-LAYING. "Tezisy Dokladov. Izd-vo Akad. Nauk SSSR, 1963". Paper presented at "5th Conference of the All-Union Entomological Society".

1124 Burgess, E.E., Bennett, S.E. STERILIZATION OF THE MALE ALFALFA WEEVIL (Hypera postica; CURCULIONIDAE) BY x RADIATION. J. econ. Ent. 59 (1966) 268-270.

Weevils were irradiated at 3 weeks. Doses of 2000 -10 000 R of x-rays were used to determine at what level of radiation sterility is induced in the male alfalfa weevil. Sterility was determined by observing the occurrence of viable or non-viable eggs laid after x-irradiated males had mated with normal virgin females. Mortality was very low and insignificant. There was no higher death rate at 10 000 R than there was at 2000 R or in the controls. Unirradiated females mated to x-irradiated males produced eggs, but most of the eggs from weevils mated with males given 2000 R through 10 000 R failed to hatch. Only 0.8% of the eggs deposited at the 4000-R level hatched. However, no hatching occurred at the higher exposures. The lower levels of radiation were successful in producing non-viable offspring, especially when comparing the experimental with the control group which produced almost 79% viable offspring. A decrease was noted in the rate of development of all embryos from sperm receiving a high level of radiation. This degree of damage increased in proportion to the dose of x-rays that the weevils received. It is concluded that doses ranging from 2000 - 6000 R will not induce sterilization in the males but will produce non-viable offspring. However, at the 8000 and 10 000 R levels sterility is induced. (Essentially NSA 20: 1966, 35279)

1125 Caprotti, M., Rubin, P.G., Springhetti, A. CASTRAZIONE DI FEMMINE ADULTE DI "Nauphoeta cinerea" [BLATTOIDEA] PER MEZZO DI RAGGI x. (Sterilization of the female adult of Nauphoeta cinerea (Blattoidea) by means of x-rays.) Genet. agr. 16 (1963) 300-306. (In Italian, with English summary) Paper presented at "Atti dell'VIII Convegno Annuale della Società Italiana di Genetica Agraria. Bergamo, Italy, 26 -28 Oct. 1961".

A dose of 10 000 rad given to the last five body segments of the white imago of N. cinerea stops egg growth in the ovary and causes their atrophy. Even two months after treatment the ovary had still not resumed normal activity.

1126 Darfenov, G.P. OCCURRENCE OF DOMINANT LETHALS IN Drosophila UNDER THE INFLUENCE OF VIBRATION, ACCELERATION AND γ IRRADIATION. Cosmic Res. 3, 4 (1965) 237-254. Also listed as N66-13790, Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

This paper presents the results of laboratory studies of the influence of vibration, acceleration, γ-irradiation and the combined effects of these factors on the occurrence of dominant lethals in the primordial cells of Drosophila males. The study was conducted to analyse the nature of the effect obtained in Drosophila in a series of space flights. It was shown that vibration and acceleration may influence the final result on indication of a biological effect of ionizing radiation by means of a given test, although in all probability they produce nonnucleic modifications. (Auth.)

1127 Flint, H.M. RADIATION STERILIZATION STUDIES ON THE TOBACCO BUDWORM, Heliothis virescens Fab. Bull. ent. Soc. Am. 12 (1966) 286. Abstr. 96, at "Portland Meeting, Portland, Oreg., USA, 28 Nov.-1 Dec. 1966".

Tobacco budworms were sterilised in the late pupal stage by 55 kR of γ-radiation. Sterilised males were ineffective in reducing egg hatch in various ratios with untreated males and females. Mating studies indicate that sperm from sterilised males are non-competitive. (Abstr.)

1128 Gasser, R. PROBLEMS OF RESISTANCE OF SPIDER MITES AGAINST MITICIDES. p.245-253 of "Proceedings of 5th European Symposium of Acarology. Milan, Italy, 23-25 Sep. 1965". 1965. 303p. (With Italian summary)

Recent published work on the cross-resistance of Tetranychids to acaricides and to mixtures of them [cf. 52: 119, etc.], their sterilisation by chemosterilants [cf. 53: 237], antibiotics [cf. 51: 578, etc.] or irradiation [cf. 53: 32] and the influence of plant nutrition on their fecundity [cf. 50: 547; 51: 583, etc.] is reviewed. The extermination (by chemical or cultural means) of small Tetranychid populations below the economic level is advocated, even at the expense of integrated control programmes, since favourable conditions can cause sudden outbreaks not easily controlled unless the most effective acaricide for the particular mite strain concerned is known. (From RAE-A 56: 1968, ref. 731)

1129 Gershenson, S. M. STUDY OF MUTABILITY IN THE WASP Mormoniella vitripennis Wlk. Genetika No. 2 (1965) 95-101. (In Russian)

A study of dominant lethals induced by x-irradiation of Mormoniella vitripennis males (dosages 4500 and 3500 R) showed that dominant lethals arise with about the same frequency as in Drosophila and Habrobracon. In recombinant males obtained by intercrossing two stocks of different geographical origin the frequency of induced dominant lethals was somewhat higher than in males of the parental stocks. A study of recessive lethals induced by x-rays in males of M. vitripennis (dosage 3500 R) showed that recessive lethals arise here also with about the same frequency as in Drosophila and again their frequency was higher in recombinant males than in males of the parental stocks. The significance of the above results is discussed in relation to the mechanism of intraspecific differentiation and the influence of hybridization on mutability. (Auth.)

1130 Gloor, H., Kobel, H.R. ANTENNAPEDIA (ss^{Anp}), AN HOMOEOTIC MUTANT OF Drosophila hydei Sturtevant. Revue suisse Zool. 73 (1966) 229-252. (In German)

A new mutant of the spineless-aristapedia type in D. hydei is described. It was produced by irradiation of the male flies with a 10 000-R dose of 60-kV x-rays delivered at a dose rate of 380 R/min. It is designated as Anp (Antennapedia). Anp is variable in its expression, is dominant, lethal when homozygous, and inseparable from an inverted transposition in the second chromosome.

Expression and penetrance of the mutant increase with higher temperatures, while at the same time viability decreases. The phenotypic effect of Anp consists, apart from various deformations of head parts, of the formation of leg-like structures on, or instead of, the antenna, leading in extreme cases to the differentiation of a nearly complete leg. A trochanter was never observed, but structures resembling a coxa may originate between antenna and eye. The homoeotic leg has in all cases the appearance of a mesothoracic leg. The mechanism of homoeotic transformation is discussed in terms of divergent gradients of growth, competing tendencies of differentiation, and prepattern formation. (NSA 21: 1967, 14628)

1131 Katiyar, K.P. Sterilization of the coffee leaf miner. p.118-122 of "The Application of Nuclear Energy to Agriculture. Annual Report". Moh, C.C., Ed. NYO-2043-52, Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica). 1 Jul. 1967, 165p.

Leucoptera coffeella Guer. has been exposed to various doses at the pupal and adult stage. 90 kR applied to newly emerged moths do not adversely affect longevity. Results are tabulated for the effect of irradiation (60 kR) applied to 7-d-old pupae on adult emergency (♂ 29.3%, ♀ 41.2% against 45.5 and 39.1 in controls) and mortality (♂88.1%, ♀ 23.6% against 0). The effect of γ-radiation on the fertility for doses from 60 to 90 kR showed a sharp drop.

1132 Khvatova, L. STERILIZATION OF PARASITES OF THE ASH TREE. Zashch. Rast. No. 12 (1965) 51-52. (In Russian)

Pupae and larvae of the wood moth, Zeuzera aesculi, were irradiated with x-rays (dose rate 112 R/min, doses from 2500, 4000 to 5500 R). The irradiated insects were placed in polyethylene bags attached to branches of the ash. After 3 d, 27 pupae had died and the remaining 43 pupae produced only 12 butterflies (eight females and four males). Butterflies from pupae which had received 2500 R could fly actively inside the bag, and their wings were fully grown and well shaped. Intensive oviposition was observed on ash leaves and branches inside the bag. Insects irradiated with 4000 R behaved similarly but their flight was less active. Butterflies from pupae irradiated with 5500 R showed degeneration, short wings and a thin, deformed body. They all died within 3 d, without any oviposition at all. Pupae obtained from irradiated parents were not checked for subsequent development.

1133 LaChance, L.E., North, D.T. GENETIC CONSIDERATION OF RADIORESISTANCE AND INHERITED STERILITY IN LEPIDOPTERAN SPECIES. Bull. ent. Soc. Am. 13, 8 (1967) 192. Abstr. 106, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

The radioresistance of Lepidopteran species to the induction of sterility is related to chromosome structure. Dose-action curves for the induction of dominant lethal mutations, and the production of sterile offspring by irradiating parents with substerilising doses is discussed in terms of its chromosomal basis and practical significance. (Abstr.)

1134 LaChance, L.E. THE INDUCTION OF DOMINANT LETHAL MUTATIONS IN INSECTS BY IONIZING RADIATION AND CHEMICALS - AS RELATED TO THE STERILE-MALE TECHNIQUE OF INSECT CONTROL. p. 617-650 of "Genetics of Insect Vectors of Disease". Wright, J.W., Pal, R., Eds. Amsterdam, Elsevier Publishing Company. 1967, 794p.

The author points out that amongst the causes of sterility involved in the sterile-male technique for insect control (infecundity and inability to mate in the females and aspermia and sperm inactivity in the males) must be included the production of dominant lethal mutations in the reproductive cells of both genes, and discusses the induction of these by x-rays and γ-radiation, the cytogenetic basis of dominant lethality, the detection of dominant lethal mutations induced in insects and the relation of these mutations to the sterile-male technique for insect control. (From RAE-B 56: 1968, ref. 563)

1135 LaChance, L.E. et al. RADIATION-INDUCED STERILIZATION. Pest. Control Biol., Phys. Sel. Chem. Methods (1967) 147-196.

Species table with dosage, and review of eradication and sterility components.

1136 Lambremont, E.N., Stein, C.I., Bennett, A.F. SYNTHESIS AND METABOLIC CONVERSION OF FATTY ACIDS BY THE LARVAL BOLL WEEVIL [Anthonomus grandis]. Comp. Biochem. Physiol. 16 (1965) 289-302.

Larval A. grandis synthesised long-chain fatty acids from labelled NaOAc in the larval diet. Larvae, pupae, and newly moulted unfed adults had an identical labelling pattern. Oleic acid possessed 60% of the incorporated radioactivity. The weevil also desaturated dietary palmitic acid and stearic acid to palmitoleic acid and oleic acid. Some dietary palmitic acid underwent chain elongation to stearic acid which was desaturated subsequently. Dietary oleic acid was not hydrogenated. The weevil was unable to form linoleic acid from acetate and could not convert closely related long-chain fatty acids into linoleic acid. The direct desaturation pathway may be in operation on all dietary long-chain fatty acids synthesised from acetate. (CA 64: 1966, 3997e)

1137 Lambremont, E.N., Bennett, A.F. LIPID BIOSYNTHESIS IN THE BOLL WEEVIL. FORMATION OF THE ACETATE PRECURSOR FOR LIPID SYNTHESIS FROM GLUCOSE AND RELATED CARBOHYDRATES. Can. J. Biochem. 44, 12 (1966) 1597-1606.

Glucose, sucrose, fructose, and their related glycolytic products, pyruvate and acetate, were readily converted into long-chain fatty acids by larval and adult boll weevils (Anthonomus grandis Boheman, Coleoptera: Curculionidae). The differentially labelled glucoses were glucose-1-^{14}C, glucose-2-^{14}C, glucose-3(4)-^{14}C, and glucose-6-^{14}C. Labelled glycolytic intermediates were acetate-1-^{14}C, acetate-2-^{14}C, pyruvate-1-^{14}C, and pyruvate-3-^{14}C. By comparison of the radiorespirometric formation of $^{14}CO_2$ of adults injected with differentially labelled glucose and pyruvate to the specific activity of lipid synthesised from these substrates, it was determined that glycolysis is the principal pathway by which acetate is produced. The patterns suggested that the boll weevil possesses the pentose phosphate pathway, which also accounts for a significant oxidation of glucose. Recombinations of labelled carbon atoms within and between intermediates of the pentose cycle allow synthesis of labelled fatty acid to take place with those carbons of glucose which could not ordinarily enter fat synthesis by glycolysis alone.

1138 Lambremont, E.N., Bumgarner, J.E., Bennett, A. F. LIPID BIOSYNTHESIS IN THE BOLL WEEVIL (Anthonomus grandis): DISTRIBUTION OF RADIOACTIVITY ON THE PRINCIPAL LIPID CLASSES SYNTHESIZED FROM ACETATE-1-^{14}C. Comp. Biochem. Physiol. 19, 2 (1966) 417-429.

The boll weevil, A. grandis, synthesised fatty acids and hydrocarbons from acetate. The fatty acids were rapidly esterified with glycerol and sterol or were incorporated into the phospholipid fraction. Radioactivity was not incorporated into the sterol fraction, an indication of the absence of sterol biosynthesis from acetate. The feeding history and developmental state of the adult boll weevil determined the eventual location of the newly synthesised fatty acids. Newly emerged unfed adults incorporated the fatty acids principally into the phospholipids. In insects injected with radiolabelled acetate after several days of feeding, the new fatty acids were distributed to the glycerides. Larvae fed a diet containing acetate-1-^{14}C had an entirely different labelling pattern with much higher amounts of ^{14}C appearing in the free fatty acid fraction. (CA 65: 1966, 17429c)

1139 Lefevre, G., Jr. STERILITY, CHROMOSOME BREAKAGE, x-RAY-INDUCED MUTATION RATES AND DETECTED MUTATION FREQUENCIES IN Drosophila melanogaster. Genetics 55, 2 (1967) 263-276.

The frequency of sex-linked recessive lethal mutations was determined following irradiation with 4000 R of male germ cells at different stages of maturity. All F_1 females were inspected for the presence of visible changes at the y, w, v, and f loci, as well as for Notch and white-mottled mutations. Further, the occurrence of hyperploid males was noted. The fertility of both phenotypically normal and mutant F_1 females was compared, as was the frequency of mutants in the fertile and sterile classes of F_1 females. - The frequency of both visible mutants and recessive lethals is high following the irradiation of mature sperm in the male, somewhat lower when mature sperm are irradiated in the female, much lower when immature sperm are irradiated (of necessity, in the male), but high again following irradiation of early spermatids. Sterility is highest when mutation frequencies are highest, except in the case of mature sperm irradiated in the female. There, sterility is increased although mutation frequencies are lower. The frequencies of different categories of mutation do not all follow the same pattern. Chromosome mutants (hyperploid males and white-mottleds) are most sensitive, sex-linked lethals (a mixture of chromosomally normal and abnormal mutants) next, and male-viable y, w, v, and f mutants least sensitive to the effect of irradiating different germ cell stages and to

irradiating mature sperm in the male and in the female. Further, visible mutants, including Notches, are eight times more frequent among sterile than among fertile F_1 females. Results indicate that differential chromosome breakage or restitution of breaks, not differential gene mutability, is primarily responsible for the differences in lethal mutation frequency detected at successive intervals following irradiation. Further, chromosome mutants contribute to both inviability and sterility of F_1 females. Thus, variations in recessive lethal mutation frequencies do not necessarily reflect true differences in the mutability of different germ cell stages exposed to given doses of x-rays. Insofar as mutants with cytologically normal chromosomes are concerned, induced mutation rates are little, if any, different in all postmeiotic male germ cell stages. (Auth. summary)

1140 Lindsley, D.L., Toledo F°, S.A., Musatti, C.C. THE CHROMOSOMAL BASIS OF THE STERILITY OF SONS OF IRRADIATED MALES IN Drosophila melanogaster. p. 141 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun.-2 Jul. 1966, 263p". Abstr. 560.

Since the original experiments of Muller demonstrating the mutagenic effectiveness of x-rays it has been known that a fraction of the sons of irradiated males are sterile; it is further known that this sterility may be associated with either the X or the Y-chromosome, but the relative sensitivities of the various elements of the chromosomal complement have not been investigated. In the present experiments the fertility of $\underline{y}\ w/\underline{y^+Y}$ sons of irradiated fathers of various constitution has been measured: the crosses were designed so that the $\underline{y}\ w/\underline{y^+Y}$ sons inherited from their father either one set of autosomes only (X/Y; A*/A), an X-chromosome and one set of autosomes (X*/Y; A*/A), a Y chromosome and one set of autosomes (X/Y*; A*/A), or both an X and a Y and one set of autosomes (X*/Y*; A*/A). The parental males were treated with 0, 1, 2, 3, or 4 kR of ^{137}Cs γ- or x-rays. The X/Y; A*/A males showed no decrease in fertility with increasing paternal irradiation dose indicating that dominant autosomal sterilizing mutations do not contribute appreciably to the observed sterility of sons of irradiated males. X*/Y; A*/A males showed approximately 1.5% and X/Y*; A*/A males approximately 3.5% sterility, attributable to effects on the X* and the Y* chromosomes respectively. X*/Y*; A*/A males showed the same degree of induced sterility as X/Y*; A*/A males, indicating a lack of independence in the response of the X and the Y which is not yet understood. Testes of sterile males were sampled for phase contrast examination and found to fall into three general categories: a) prespermatogenic sterility in which the testes are virtually acellular and which is not dose dependent; b) spermatogenic sterility in which nonmotile sperm are produced and which is strongly dose dependent; and c) postspermatogenic sterility in which the seminal vesicles are distended with motile sperm that are not transmitted to females and which is not strongly dose dependent. (Abstr.)

1141 Mayer, M.S., Brazzel, J.R. LABORATORY STUDIES TO STERILIZE THE BOLL WEEVIL WITH RADIATION. Ann. ent. Soc. Am. 59, 2 (1966) 284-290.

γ-radiation of 7200 R or less delivered to 12- or 36-h-old eggs of the boll weevil, Anthonomus grandis Boheman, failed to sterilise, but did decrease the longevity of ensuing adults. Doses of 800-24 250 R applied to 12- to 36-h-old pupae failed to sterilise the adults at any dose low enough to permit adult survival for at least 10 d with sufficient vitality to copulate. A dose of 8000 R delivered to 12- to 36-h-old adults reduced sperm fertility to about 18%; these adults lived for as long as 20 d and mated apparently normally for at least 10 d post-irradiation. Multiple mating experiments indicated that the last mating of the female was the effective one, but only if it was with a normal male: otherwise, there was a competitive effect between the irradiated and nonirradiated sperm. (Auth.)

1142 North, D.T RADIATION-INDUCED MALE STERILITY EXHIBITED IN THE P_1 AND F_1 GENERATION IN LEPIDOPTERA. Radiat. Res. 31, 3 (1967) 615. Abstr. Eb-9, at "15 Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Adult cabbage looper (Trichoplusia ni) males demonstrate a high degree of radioresistance to the induction of sterility. The dose required to induce dominant lethal mutations in all of the sperm in the adult male is 35 000 rad, a tenfold difference in contrast with Dipteran species. The radioresistance of the Lepidopteran species had been attributed by some workers to: (1) the chromosomes being either polycentric or having diffuse centromeres; and (2) a high chromosome number with extremely small chromosomes. F_1 progeny from a cross involving a normal female and a male administered a substerilising dose of radiation are also partially sterile. This is a major deviation from known causes of radiation induced male sterility - namely, dominant lethal mutations. The cytogenetic implication of these data were discussed. (Abstr.)

1143 Oftedal, P. MUTATION YIELD IN A THEORETICAL CELL POPULATION OF HETEROGENEOUS SENSITIVITY TO MUTATION INDUCTION AND TO KILLING. 1) "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy, 26 Jun.-2 Jul. 1966". 2) AED-Conf-226-77, Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany). 1966, 2p.

If there is a relationship - other than random - between radiosensitivities to killing and to mutation induction, killing of cells will influence the yield of mutations. This has been investigated in a theoretical test system, using three different sensitivity patterns for mutational response, and three patterns for the killing effect. The patterns used have in common that part of the population (or cell cycle) is sensitive, and part is resistant. The difference is about 40-fold in genetic response and about 6-fold in MLD. Within the sensitive fraction, there are differences in shape between the genetic patterns used, and in MLD and extrapolation number between the killing patterns. Mutation yields have been calculated for different sensitivity pattern combinations, for different distributions of sensitive and resistant phases, and for different degrees of coincidence in the cell cycle of the two types of sensitivity. With positive coincidence of sensitivities, a humped dose-effect curve for mutations is always found. The initial low-dose slope is equal to the built-in mean genetic sensitivity, changing with high dose to the lower slope characteristic of the resistant phase sensitivity. The hump is higher with higher extrapolation number, and is shifted to the right when the sensitive phases are more extensive. When coincidence between sensitivities is altered from complete positive to complete negative, the dose-effect curve changes from the humped type, through a more or less linear form, to a form with a "negative" hump, where the curve appears exponential in the built-in mean genetic sensitivity*.

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* The above was discussed in relation to non-linear dose effect curves found in experimental work.

1144 Osborn, A.W., Shipp, E., Hutchinson, P.B. BIOLOGY AND RADIATION STERILIZATION OF SUGAR CANE LEAFHOPPERS. Atom. Energy Aust. 9, 4 (1966) 11-19.

An important disease of sugar cane in the Pacific areas is Fiji disease which is caused by a virus transmitted by leafhoppers, Perkinsiella spp. The possibility of eradicating leafhoppers by repeated releases of sterile insects was investigated. Several varieties of sugar cane were tested for suitability for mass-rearing experiments. Studies were conducted on the effects of nitrogenous fertilizer on fecundity of leafhoppers and on the most suitable temperature for mass-rearing of Perkinsiella saccharicida. Nymphal instars were irradiated with ^{60}Co to obtain sterility while maintaining mating competitiveness. Natural population fluctuations were studied in Australia and in Fiji. The most important factors influencing populations were rainfall, temperature, nitrogen content of sugar cane leaves, and egg predator, Cyrtorhinus mundulus. Results at present indicate that a successful sterile insect release programme can be carried out economically on sugar cane leafhoppers.
(NSA 21: 1967, 20468)

1145 Petrushova, N. I. SEXUAL STERILIZATION IN THE FIGHT AGAINST CODLING MOTH IN APPLE. Zashch. Rast. No. 10 (1967) 26-27. (In Russian)

A ^{60}Co source was used to sterilise Carpocapsa pomonella (male nymph) using a 25-31 kR dose of γ-rays at 1080 R/min. This resulted in 96-100% sterile eggs; oviposition, longevity, and mating frequency were not affected by such irradiation doses.

1146 Popa, A., Mihalache, G. ON THE RADIOACTIVE ISOTOPE UTILIZATION FOR FOREST PROTECTION. Revtă Pădur. 80 (1965) 59-62. (In Rumanian)

Some researches have been carried out on the Lymantria dispar fly control by irradiating their pupae with ^{60}Co sources. The analysis of the results shows that ionized radiations emitted by ^{60}Co cause the L. dispar pupae sterilisation, the most convenient radiation dose being 5000 R. During the tests performed in the laboratory and followed by larger experiences in different variants, it was found that the fecundity was reduced up to 50% as against the control subjects in the variants where irradiated pupae have been introduced. The wider actions that were performed, destroyed nearly entirely some dangerous pests on rather large areas. (Auth.)

1147 Rossi, H.H., Goodman, L.J. ANNUAL REPORT ON RESEARCH PROJECT. Dosimetry of monoenergetic neutrons for Drosophila. p. 70-72 of "Annual Report on Research Project", NYO-2740-4, Columbia Univ., New York. Radiological Research Lab. 1 Jan. 1967.

A pilot study is discussed aimed at determining the approximate proportion of dominant lethals in male D. melanogaster irradiated with several different doses but at a single neutron energy. In the preliminary study the flies are to be exposed to 1-MeV energy neutrons obtained from a Van de Graaff generator utilising 2.8 MeV protons. The aluminium/lucite irradiation cage is illustrated.

1148 Shazli, A. EXPLORATORY STUDIES ON FREQUENCY OF COPULATION IN Prodenia litura F. (LEPIDOPTERA: NOCTUIDAE). Bull. Soc. ent. Egypte 47 (1963) 65-73.

The following is based on the author's summary of this account of laboratory investigations in Egypt to determine the practicability of releasing sterile males for the control of Spodoptera littoralis (Boisd.) (P. litura, auct.). Females stimulated by the presence of males that had been sterilised as pupae by irradiation with x-rays laid sterile eggs in regular batches. They had evidently paired, since others that were kept without males laid scattered eggs or eggs in small batches that were not covered in the normal manner. When the sterile males were replaced by fertile ones, the females paired again and deposited fertile eggs in batches. Exposure of male pupae to radiation at 5000 R increased pupal mortality and the percentage of abnormal adults, lengthened the pupal period and reduced fertility, but exposure to 3000 R had no adverse effects. The release of sterile males for the eradication of S. littoralis is considered to be impracticable because of the tendency of the females to pair more than once and difficulty in rearing large numbers of larvae. (RAE-A 55: 1967, ref. 892)

1149 Shipp, E., Osborn, A.W., Hutchinson, P.B. RADIATION STERILIZATION OF SUGAR-CANE LEAFHOPPERS OF THE FAMILY DELPHACIDAE. Nature, Lond. 211 (1966) 98-99.

Preliminary experiments have been carried out on the applicability of the sterile male technique to sugar-cane leafhoppers (Perkinsiella saccharicida (Kirk)), vectors of Fiji disease of sugar cane. 5th-instar nymphs proved the most suitable stage for irradiation with γ-rays from a ^{60}Co source. Females were sterilised at 3500 rad, males at 10 000 rad. No effects were observed at those dosages on adult longevity, mating behaviour and sperm motility. A percentage of sperm were rendered inactive at 12 000 rad, and at 23 000 rad adult longevity and wing development were also affected adversely. A large safety margin is indicated within which sterility may be produced without adverse effects.

1150 Smith, R.H., Whiting, A.R., Bostel, R.C. von, Cain, K.T., Goins, D.J., Sirota, E.S., Haye, M.L. x-RADIATION INDUCTION OF MUTATIONS IN Habrobracon. p. 64 of "Biology Division Semiannual Progress Report for Period Ending July 31, 1966", ORNL-3999, Oak Ridge National Lab., Tenn. 1966, 217 p.

Techniques have been developed which permit analysis of the entire genome for dominant lethality, recessive lethality and chromosomal translocations. Lemon males irradiated with 2000 R x-rays were crossed with Raleigh females of high hatchability. The frequency of dominant lethality (from egg hatchability, testing 6045 eggs) was 0.279. Tests for recessive mutations and translocations showed that mutation frequencies remained essentially constant for three replicates taken at approx. monthly intervals.

1151 Strømnaes, Ø. THE x-RAY SENSITIVITY OF TWO WILD TYPE STRAINS OF Drosophila melanogaster. p. 196-200 of "Progress in Radiobiology". Proceedings of the "4th International Conference on Radiobiology. Cambridge, England, 14-17 Aug. 1955". Mitchell, J.S., Holmes, B.E., Smith, C.L., Eds. Edinburgh, Scotland, Oliver and Boyd. 1956, 557p.

Two wild type strains of D. melanogaster were tested with respect to the induction of dominant lethals by x-rays. Eleven repeats of the same experiment were performed, and in 10 of them one strain consistently exhibited lower hatchability than the other after x-ray treatment of the males. Some of the repeats were performed in Berkeley, Calif., and some in Oslo, Norway. It is suggested that the difference in hatchability observed between repeats executed in the two places is mostly due to discrepancy in the technique of measuring and applying x-ray dosage. (Auth. summary)

1152 Strømnaes, Ø. MUTATION PATTERN IN TWO WILD-TYPE STOCKS OF Drosophila melanogaster. Paper presented at the "10th International Congress of Genetics. Proceedings, Vol. 2. Montreal, Canada, 1959".

The mutation pattern has been investigated in two wild-type stocks of D. melanogaster, one is Oslo, the other is Iso-Amherst. Males, 1-4 h old, from the two stocks were treated with 1800 R of x-rays, then mated individually to single females for 24 h and transferred to new females every 24 h for a period of 12 d. In testing for dominant lethals virgin hybrid females from a cross between cn bw; e^{11} ♀ × Canton-S ♂ were used; in testing for sex-linked lethals the Muller-5 technique was employed, and in testing for 2-3 translocations a cn bw; e^{11} stock was used. The daily brood pattern for dominant lethals for the two stocks shows up as similar curves. However, dominant lethal frequency is higher for Oslo stock than for Iso-Amherst stock in all first broods until the seventh brood where it is the same for both. From the 8th-12th brood the situation is reversed: max. frequency of dominant lethals for the Osla stock appears in the sixth brood: for the Iso-Amherst stock in the 8th brood. Tests for sex-linked lethals and 2-3 translocations were carried out only for sperms coming on the third, sixth, and eighth day after irradiation of the males. The data observed for 2-3 translocations are in good agreement with the data found for dominant lethals. The observed data indicate an overall higher mutation rate in the Oslo stock than in the Iso-Amherst stock. It seems reasonable to assume that the different mutability of the stocks has been achieved by selection during the evolution of the two stocks in order to make them better adapted to their natural environment. (From abstr.)

1153 Subrahmanyam, U. SOME EFFECTS OF GAMMA IRRADIATION ON NAVEL ORANGE-WORM, Paramyelois transitella (Walker). Bull. ent. Soc. Am, 13, 3 (1967) 203. Abstr. 356, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

60 000 rad of γ-radiation induced 99% dominant lethality in navel orange-worm, P. transitella. Effects of irradiation were also studied on the male vigour, spermatazoa competition, spermatophore production and the F_1 and F_2 generations. (Abstr.)

1154 Tzanakakis, M.E., Tsitsipis, J.A., Papageorgiou, M., Fytizas, E. GAMMA RADIATION-INDUCED DOMINANT LETHALITY TO THE SPERM OF THE OLIVE FRUIT FLY. J. econ. Ent. 59 (1966) 214-216.

Research carried out in 1964-65 at the "Democritus" Nuclear Research Center has ascertained that when pupae of the olive fruit fly, Dacus oleae (Gmelin), are exposed to 8, 10, and 12 krad of γ-rays, permanent dominant lethality is caused to sperm to a degree which can be considered satisfactory for practical purposes. It has shown also that 6 krad was a satisfactory male-sterilizing dose. At these doses not more than 2.6% of the progeny of irradiated males mated with normal females reached the first larval instar, and not more than 0.3% reached the pupal stage, as compared with 82.3% and 41.4% in the control, respectively. The same doses caused permanent sterility to the irradiated females. They did not substantially affect the time or the percent of adult emergence, or the longevity of irradiated males. (Auth.)

1155 Volchkok, A., Vorobtsova, I.E. COMPARATIVE STUDY OF THE FREQUENCY OF OCCURRENCE OF DOMINANT LETHAL MUTATIONS IN DIFFERENT LINES OF Drosophila melanogaster. Vest. leningr. gos. Univ. 3, 15 (1964) 124-129. Translation Leningrad Univ.

The genetic radiosensitivities of 8 stocks of the wild type of D. melanogaster were compared. A dose producing 50% of dominant lethals in spermatozoa was taken as criterion of genetic radiosensitivity. On this basis the 8 stocks could be divided into two groups: the relatively radiosensitive were lines R-86, Tsentrospirt-1, D-18 and Kanton-S; the relatively radioresistant lines were Inozemtsevo, D-32, SH-15, and Magarach. Stocks with different correlation between induced and spontaneous mutation processes were discovered.

1156 Walker, D.W. RADIATION-INDUCED STERILITY FOR POPULATION CONTROL OF THE SUGARCANE BORER (Diatraea saccharalis) IN PUERTO RICO. PRNC-95, Puerto Rico Nuclear Center, Mayaguez. May 1966, 47p.

Progress is reported on studies concerned with radioinduced sterility of the sugarcane borer, D. saccharalis for population control. Research problems on development of a more efficient rearing medium: effects of yearly seasons on the life span of the cane borer: egg productivity and

mating behaviour of radiosterilized insects; γ-radiation dosimetric measurements; rate of larval growth and maturation during different seasons; seasonal population fluctutations; and stages of egg maturation are outlined and discussed. It was established that only adult stages of this species could be sterilized with γ-radiation without mortality and that radiosterilized females and males were as competitive in mating as normal adults. (NSA 21:1967, 22830)

1157 Walker, D.W., Quintana, V. INHERITED STERILITY IN SURVIVORS OF IRRADIATED Diatraea saccharalis (Fab.) (LEPIDOPTERA: CRAMBIDAE). Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 107, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Partial sterility and reduced survival was observed in the F_2 generation following exposure of P generation adults of the sugarcane borer moth, D. saccharalis to ^{60}Co γ-radiation. The sterility effect was noted in offspring from both irradiated males and females. (Abstr.)

1158 Walker, D.W., Quintana, V. GAMMA-INDUCED STERILITY IN THE SUGARCANE MOTH, [Diatraea saccharalis (Fab.) (LEPIDOPTERA: CRAMBIDAE)]. Radiat. Res. 31, 3 (1967) 612. Abstr. Eb-1, at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Immature stages of D. saccharalis are less radioresistant than the adult with over 50% mortality at exposure to 9 kR. Adult males are sterilized at 35 kR and adult females at 30 kR. Lifespan, mating behaviour and oviposition rate is not affected by sterilizing exposures given to adults. Response to substerilizing exposures is erratic, but appears to be logarithmic. The diffuse centromere in chromosomes of this species may be the explanation for inconsistent response at low exposure. (Abstr.)

1159 Yoshimeki, M., Newsom, L.D., Roddy, J. L. EFFECT OF HOST EGGS DERIVED FROM IRRADIATED PUPAE OF THE SUGARCANE BORER ON Trichogramma PARASITISM. Bull. ent. Soc. Am. 13, 3 (1967) 203. Abstr. 357, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Host eggs were derived from the irradiated pupae to obtain the sterile sugarcane borer moths for the pest control programme, and were exposed to the laboratory reared Trichogramma colony. The indirect effect of the radiation on the oviposition and the parasitism were compiled comparing different radiation intensities. (Abstr.)

See also:

918 Induction of nuclear damage by ionizing and ultraviolet radiation. (Borstel, R.C. von., 1961)
919 Effects of radiation on cells. (Borstel, R.C. von., 1966)
925 The cytogenetic basis of radioresistance in Lepidoptera species, Trichoplusia ni. (North, D.T. et al., 1967)
927 A cytological study of radiation effects in testes of the screw-worm fly, Cochliomyia hominivorax (Diptera: Calliphoridae). (Riemann, J.G., 1967)
928 Cytological evaluation of dose-rate effects of radiation on mutation frequency of silkworm gonia. I. Kinetics of proliferation and killing of spermatogonia during chronic irradiation. (Sado, T., 1966)
940 Radiomutability and heterogeneity of male germ cells of Drosophila before, during, and after meiosis. (Fritz-Niggli, H., 1966)
948 Effect of gamma rays on development of the sex cells in the beet fly. (Klimtnya, A.Y., 1965)
956 Relation between sensitivity to killing and mutation observed during a mitotic cycle of silkworm cleavage nuclei. (Murakami, A., 1966)
959 Fifth report from Norsk Hydro's Institute for Cancer Research for 1963-1964. (Norsk Hydro's Inst. for Cancer Research, Oslo, 1965)
963 Techniques for studying the effects of radiation on meiosis and related processes in mosquitoes with particular reference to Aedes aegypti. (Rai, K.S., 1968)
972 Dose rate effect of radiation on spermatogonia of the silkworm. (Sugai, E. et al., 1967)
982 Methods for radiation studies during oogenesis in Habrobracon juglandis (Ashmead). (Whiting, A.R. et al., 1968)

984 Induced mutations and lethality in Drosophila after x-irradiation of meiotic and post-meiotic stages of the egg. (Würgler, F.E., 1968)

1071 The radiologist and practitioner in relation to the supposed hazards of x-rays in radiodiagnosis. (Gros, C.M. et al., 1962)

1092 Mutagenic effects of massive acute x-irradiation in Drosophila melanogaster. (Nakao, Y. et al., 1965)

1093 Comparisons of mutagenic and cell-killing effects of radiation in the silkworm. (Nakao, Y. et al., 1965)

1191 Modification of induced genetic damage in Drosophila melanogaster by oxygen and argon treatments between two doses of x-rays. (Elequin, F.T., 1966)

1198 Occurrence of lethal mutations in the heterochromatinic region of Drosophila melanogaster X chromosome depending on preradiational development temperature. (Kogan, Z.M., 1966)

1224 The effects of nitrogen and oxygen treatments on the frequencies of x-ray-induced dominant lethals and on the physiology of the sperm in Drosophila melanogaster. (Sankaranarayanan, K., 1967)

1233 Effect of aeration on gamma irradiation of house fly pupae. (Smittle, B.J., 1967)

1246 Genetic x-radiation damage and its modification by some gases and a time factor in Drosophila melanogaster. (Yoon, J.S., 1966)

1249 Retention of the blood-meal in Aedes aegypti following sterilization by chemicals and irradiation. (Akov, S., 1966)

1256 A comparison of the sterilizing effect of x-rays, quinacrine mustard and azaserine on Drosophila males. (Browning, L.S. et al., 1965)

1257 The sterilisation of lepidopterous pests by radiation and chemosterilants. (Campion, D.G., 1967)

1258 Sterilizing effect of γ-rays and apholate on the Mexican bean beetle, Epilachna varivestis Muls. (Carillo, J.L. et al., 1963/1964)

1267 Effects of gamma radiation and chemosterilants on the cattle tick, Boophilus microplus. (Kitaoka, S. et al., 1967)

1268 Sterilization of boll weevils with combinations of chemosterilants and radiation. (Klassen, W. et al., 1967)

1279 Effect of temperature on radiation induced male sterility in the silkworm Bombyx mori L. (Sugai, E., 1965)

1281 Progress in the sterilization of the European pine shoot moth. (Taylor, K.B. et al., 1966)

1291 An attempt to obtain sterility of male rice hispa through gamma radiation. (Abdul Matin, A.S.M. et al., 1966)

1300 x-Radiation and temperature modification of reproductive performance of single-species and mixed-species cultures of Tribolium confusum and Tribolium castaneum. (Erdman, H.E., 1966)

1302 Effects of gamma radiation on fertility, mating and longevity of males of the oriental fruit moth, Grapholitha molesta (Lepidoptera: Tortricidae) (George, J.A., 1967)

1307 Laboratory and field cage studies of the effects of gamma radiation on codling moths. (Hathaway, D.O., 1966)

1308 Some effects of gamma radiation and apholate on the fertility of Drosophila melanogaster. (Henneberry, T.J. et al., 1967)

1309 Some irradiation studies and related biological data for Culicoides variipennis (Diptera: Ceratopogonidae). (Jones, R.H., 1967)

1331 Irradiation effects on midguts and testes of the adult boll weevil, Anthonomus grandis, determined by histological and shielding studies. (Riemann, J.G. et al., 1967)

1338 Observations on the behaviour of pupae of Hyphantria cunea Drury irradiated with γ-radiation. (Boguleanu, G., 1965)

1341 A study on the life history and the effect of radiation on rice weevil (Sitophilus oryzae L.) (Chettachai Baditsing, 1966)

1350 Ontogeny and x-radiation sensitivity of the flour beetle, Tribolium. (Erdman, H.E., 1967)

1354 Stérilisation de la mouche méditerranéenne des fruits, Ceratitis capitata Wied., par irradiation des pupes aux rayons gamma. (Féron, M., 1966)

1355 Gamma irradiation of pupae of the tobacco budworm. (Flint, H.M. et al., 1967)

1360 Effect of x and γ-radiation on the development of unmatched gypsy moths (Ocneria dispar L., Lymantriidae, Lepidoptera). (Kakhmanyuk, F.S. et al., 1967)

1366 Sterilization of onion maggots by irradiation with cesium-137. (McClanahan, R.J. et al., 1966)

1378 The effects of gamma radiation upon various stages of Fannia canicularis (L.) (Nelson, T.E., 1966)

1391 Effects of gamma radiation on Rhyzopertha dominica, Sitophilus oryzae, Tribolium confusum, and Lasioderma sericome. (Tilton, E.W. et al., 1966)

1396 Effect of gamma irradiation on the development and sterility of Angoumois grain moth (Sitotroga cerealella Oliv.). (Yupares Permswang, 1966)

1430 Radiation effect on red flour beetle (Tribolium castaneum Hbst.). (Boontiam Disyam, 1966)

1431 Radiation sterilization of the black blow fly. (Bushland, R.C., 1966)

1439 Radiation studies with the boll weevil: lethal effects on larvae, pupae, and adults; male sterility and dose fractionation. (Flint, H.M. et al., 1966)

1444 Studies on the use of gamma radiation in the control of pea weevil (Callosobruchus chinensis L.). (Srisan Ruangopas, 1966)

1448 Mortality staging of dominant lethals induced in the sugarcane borer Diatraea saccharalis (F.) (Crambidae, Lepidoptera). (Walker, D.W. et al., 1966)

1471 The effects of gamma radiation on mating competitiveness and fecundity of Hippelates pusio Loew. (Flint, H.M., 1966)

1472 Effect of mating sequence on egg-hatch from female Aedes aegypti (L.) mated with irradiated and normal males. (George, J.A., 1967)

1477 Mating competition of gamma-irradiated and non-irradiated male Trogoderma glabrum Herbst. (Tilton, E.W. et al., 1966)

1479 The effects of gamma radiation on the biology and behaviour of adult Ips confusus (LeConte) (Coleoptera: Scolytidae). (Wood, D.L. et al., 1967)

1491 A study of the genetic processes in irradiated populations of Drosophila melanogaster. III. The fecundity and the concentration of lethal mutations. (Bileva, D.S., 1967)

1514 An estimate of the effects of fallout beta radiation on insects and associated invertebrates. (Teresi, J.D. et al., 1966)

1538 Prospects of integrated microbial and radiation control of harmful insects. (Jafri, R.H., 1967)

1559 Progress in insect control by irradiation induced sterility. (Cutcomp, L.K., 1967)

1563 Control of an insect population by means of the sterile male technique. (Katiyar, K.P., 1967)

1569 Radiation-induced sterilization. (LaChance, L.E. et al., 1967)

1578 Cobalt-60 sterilization studies with the European chafer. II. (Chung, S.L. et al., 1966)

1583 Studies on the eradication of Anopheles pharoensis Theobald by the sterile-male technique using cobalt-60. I. Biological effects of gamma radiation on the different developmental stages. (Abdel-Malek, A.A., et al., 1966)

1584 Studies on the eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. III. Determination of the sterile dose and its biological effects on different characters related to "fitness" components. (Abdel-Malek, A.A. et al., 1967)

1585 Studies on the eradication of Anopheles pharoensis Theobald by the sterile-male technique using cobalt-60. VI. Sperm activity in males irradiated with the sterilizing dose. (Abdel-Malek, A.A. et al., 1967)

1591 Laboratory and field studies with ^{60}Co sterilized horn flies. (Hoffman, R.A. et al., 1966)

1592 Control of fruit flies by gamma rays. (Huque, H. et al., 1966)

1593 Control of fruit flies Dacus zonatus Saunders by gamma-rays. (Huque, H. et al., 1967)

1598 Determination of the sterilization dose of the medfly with OIRSA Co-60 irradiator. (Katiyar, K.P., 1967)

1608 Study of the biology, breeding and sterilisation of the cabbage fly, Phorbia brassicae Bouché, with special reference to its occurrence in radish cultures. (Riedel, M., 1967)

1609 Study on mass breeding and sterilisation of the Mediterranean fruit fly Ceratitis capitata Wied. (Scherney, F. et al., 1967)

1610 Studies on eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. II. Induced dominant lethals in the immature stages. (Tantawy, A.O. et al., 1966)

1614 Sterile flies used. Enemy of olives subjected. (Whitney, D., 1966)

1618 Prospective use of radiation to control the hollyhock seed moth (Lepidoptera, Gelechiidae). (Azaryan, G.K. et al., 1965)

1619 Sterile moths in Canada - bewildered, but effective. (Madsen, H.F., 1965)

1620 Codling moth control. (Madsen, H.F. et al., 1967)

1622 Studies on the application of the sterility method in the tick Omithodoros tholozani. (Galun, R. et al., 1967)

1633 Can nuclear energy be used for the protection of cereal stores against insects? (Pesson, P., 1965)

1657 Status of irradiation control of insects in grain. (Cornwell, P.B., 1966)

1662 Radiation disinfestation of grain and seeds. (Golumbic, C. et al., 1966)

1668 Food irradiation research and pilot facilities in operation or planning in India. (Kumta, U.S. et al., 1966)

1684 L'effort belge en matière d'irradiation des aliments. (Proost, M., 1965)

1686 Gamma irradiation of grain and other reserves for sterilizing and exterminating pests. (Rukavishnikov, B.I., 1964)

1696 Irradiation of mangoes for control of the mango seed weevil (Sternochetus mangiferae). (Upadhya, M.D. et al., 1966)

1712 Central Africa. I. The USDA research team for the chemosterilisation of tsetse flies. III. The radio-sterilisation of tsetse. (2 papers). (Dame, D.A. et al., 1965)

1791 "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology, Gainesville, Fla., 4 Oct.-26 Nov. 1965". (International Atomic Energy Agency, Vienna/Austria/. et al., 1965)

2.1.7. Pesticide Resistance. Pathogen Susceptibility. Effects on Pathogens

1160 Berdjis, C.C. et al. VIRUS INFECTION AND x RADIATION: A COMPARATIVE STUDY OF INFECTION WITH AN ATTENUATED VENEZUELAN EQUINE ENCEPHALOMYELITIS VIRUS AND OF x RADIATION. J. infect. Dis. 109, 1 (1961) 62-70.

1161 Erdman, H.E. RADIATION AND DDT EFFECTS IN FLOUR BETTLES. p. 19-22 of "Pacific Northwest Laboratory Annual Report for 1965 in the Biological Sciences". BNWL-280, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Jan. 1966, 150p.

Modification of fitness parameters of homogenic populations singly or doubly stressed with x-radiation and DDT were specific for species and strains of flour beetles (Tribolium). (Auth.)

1162 Guenthner, A.W., Ware, G.W. EFFECTS OF x-IRRADIATION ON TOXICITY OF MALATHION, HEPTACHLOR, AND TEMIK TO THE HOUSE FLY. J. econ. Ent. 60, 2 (1967) 369-373.

Dosage-mortality studies were conducted on both sexes of houseflies, Musca domestica L., the pupae receiving 5000 R x-irradiation. Single doses of the toxicant were applied to flies from pupae which had been irradiated with 7500 and 10 000 R, and to flies receiving 25 000, 50 000, and 75 000 R immediately before topical application. Generally, irradiation of pupae (1) increased toxicity of heptachlor to males and females; (2) reduced significantly the toxicity of malathion to females, with no effect on males; and (3) reduced significantly the toxicity of Temik® (2-methyl-2-(methylthio) propionaldehyde O-(methylcarbarbamoyl) oxime) to males, with no effect on females. Irradiation of adults (a) had no evident effect with heptachlor for either sex; (b) had no effect with malathion; and (c) increased significantly the toxicity of Temik to both sexes at 75 000 R. It is suggested that the phenomenal response observed in (2) may be attributed to altered ^{32}P ratios or increased levels of esterases involved in detoxication of malathion. (Auth.)

1163 Jafri, R.H. SUSCEPTIBILITY OF IRRADIATED INSECTS TO Bacillus thuringiensis INFECTION. p. 351-354 of "International Colloquim of Insect Pathology. Paris, 1962".

Experiments were performed on the susceptibility of x-irradiated Tribolium beetles to non-specific bacterial toxin or to B. thuringiensis infection. Tribolium confusum and T. castaneum beetles were exposed to x-ray doses of 100, 50000 or 90000 R. T. confusum beetles were offered wheat flour (containing spores of B. thuringiensis) immediately after treatment 24 h post irradiation, and on the 7th day after exposure to the x-ray dose. T. castaneum beetles, having latent infections of Farinocystis tribolii and Nosema whitei, were fed wheat flour (containing spores of B. thuringiensis) immediately after exposure. T. confusum beetles receiving nonspecific bacterial toxin immediately after

exposure to 100, 50 000, or 90 000 R showed a gradually higher rate of mortality and mortality time was shortened as the dose was increased from 100 - 90 000 R. Mortality time of x-irradiated beetles receiving bacterial toxin on 7th day after irradiation showed a gradual rise in mortality and a sharp decrease in total mortality time as the dose was increased from 100 to 90 000 R. The comparative mortality pattern indicated not only decreased resistance of the irradiated hosts and higher susceptibility to B. thuringiensis toxin but also suggested the significant role of the time factor in administration of pathogen or toxin to the irradiated insects. The total mortality time of beetles manifesting latent infections of F. triboli and N. whitei was shortened as the dose was increased from 100 - 90 000 R. These findings indicated that protozoan-infected beetles were more sensitive to radiation. The total mortality pattern of the irradiated beetles developing B. thuringiensis vegetative cells and of beetles manifesting no infection depended on the radiation dose. However, overall mortality time of beetles with B. thuringiensis vegetative cells was considerably decreased after exposure to different x-ray doses as compared to control nonirradiated beetles. These results suggested new means of biological and radiation control of stored grain pests and showed the practical importance of exploring the potentialities of bacterial toxins and of protozoan diseases in controlling nonirradiated and irradiated insects of economic importance. (NSA 21: 1967, 24632)

1164 Jafri, R.H. SYNERGISTIC ACTION OF RADIATION AND OF Bacillus thuringiensis TOXIN ON PROTOZOAN DISEASES OF INSECTS.* Int. Congr. Protozool. (1963) 510-515. Also presented at "1st International Conference on Protozoology. Prague, Czechoslovakia, 22-31 Aug. 1961".

Experiments are reported on the synergistic action of x-rays and of B. thuringiensis toxin on flour beetles, Tribolium castaneum and T. confusum, that were infected with the coccidian Adelina tribolii, the macrosporidian Nosema whitei (in T. confusum), or the schizogregarine Farinocystis tribolii (in T. castaneum). The beetles were exposed to x-ray doses ranging from 100 - 90 000 R. The mortality rate in noninfected, infected, and doubly infected beetles was evaluated. Mortality of Farinocystis-infected beetles after x-ray treatment was most markedly increased after low doses of x-radiation. In comparison to the mortality of infected, nonirradiated beetles, the 100-R dose increased mortality 3 to 4-fold in T. castaneum during the 1st 40 d after treatment. The increase in mortality of beetles irradiated by higher doses (60 000 and 90 000 R) was less marked. The reaction of infected beetles to the 100 R dose during the 1st 15 d was the same as that of non-infected beetles exposed to 90 000 R. Similar synergistic effects were recorded for A. tribolii-infected T. confusum beetles. Mortality of non-infected beetles exposed to 60 000 and 90 000 R was lower than that of the infected ones. In general, diseased adults of both flour beetles were highly susceptible to x-rays. Only a low toxicity of the B. thuringiensis toxin for the flour beetles was seen. Adelina-infected adults were killed in half the time required for the death of the noninfected beetles when a concentration of 25×10^7 spores of B. thuringiensis was used in the feeding flour. In larvae, the effect of bacteria or the combination of bacteria and Adelina infection was much slower but still significant. (NSA 21: 1967, 26592)

* Originally cited without abstract (see III/890)

1165 Karpov, A.E. THE ROLE OF x-RAY IRRADIATION IN THE PATHOGENESIS OF NUCLEAR POLYHEDROSIS OF INSECTS. (BAg30: 1966, 88120) Vop. Biofiz. Mekhanizma Deistviya Ioniz. Radiat. (1964) 356-359.

1166 Podolyan, V.Y. THE PATHOGENIC EFFECT OF SMALL AND AVERAGE DOSES OF GAMMA-RAYS ON FUTURE GENERATIONS OF IRRADIATED INSECTS. Trudy Inst. Zool., Alma-Ata 19 (1963) 220-225. (In Russian) Translation: Referat. Zh. Biol. (1964) 1E4.

Studies were made of the effect of γ-radiation at 100, 250, 500, 1000, and 1500 R given to irradiated imagoes of Protophormia terrae-novae in the F_1 to F_5 generations. Results show both large and comparatively small doses of γ-rays have a pathogenic effect. Small and intermediate doses of γ-rays are dangerous not only because of immediate somatic damage, but also because of injury to following generations (low fertility in the females, a large percentage of unfertilized eggs, a high death rate among larvae and cocoons). (BA)

1167 Stahler, N., Terzian, L.A. REPRODUCTIVE AND IMMUNOLOGICAL CHARACTERISTICS OF A STRAIN OF Aedes aegypti SELECTED FOR RESISTANCE TO GAMMA RADIATION. Ann. ent. Soc. Am. 59, 4 (1966) 763-765.

A strain of A. aegypti (L.), mass selected for resistance to γ-radiation, mated readily with the parent strain and showed no reproductive isolation. Oviposition rates, and usually susceptibility to malarial infection, were reduced in the selected strain, as well as in the parent stock, which had been irradiated as eggs. After 20 successive generations of inbreeding without exposure to radiation, the offspring of the selected strain continued to show a significantly greater radiation resistance than the parent strain. (Auth.)

1168 Terzian, L.A., Stahler, N. A SELECTED STRAIN OF Aedes aegypti RESISTANT TO GAMMA RADIATION. Radiat. Res. 28 (1966) 643-646.

Eggs (10-d-old) of both a selected strain and the parent NMRI strain of the mosquito A. aegypti were exposed to 2000 R γ-radiation at the rate of approx. 200 R/min in air. The eggs of the selected strain were found to be more resistant to the effects of this dose of γ-radiation than were the eggs of the parent strain, since a significantly higher proportion of the larvae from irradiated eggs survived to become viable adults. On the other hand, adults of the selected strain derived from eggs not exposed to radiation died more quickly and had a significantly shorter life span than the adults from the non-irradiated eggs of the parent colony. (NSA 20: 1966, 33032)

1169 Vashkov, V.I., Poleshchuk, V.D. EFFECT OF x-IRRADIATION ON INSECT SENSITIVITY TO INSECTICIDES. Zh. Mikrobiol. Épidem. Immunobiol. 43, 8 (1966) 9-11. (In Russian)

Female houseflies (Musca domestica) were irradiated with x-rays. Small doses of x-rays stimulated their viability. The LD 50 was 100 000 rad, the LD 100 was 130 000 rad. Sensitivity of flies to insecticides was determined after a topical application of alcoholic solutions of DDT, hexachlorocyclohexane, and chlorophos. LD 50 values of DDT, hexachlorocyclohexane, and chlorophos were 8, 0.3 and 0.85 μg/fly, respectively. After the irradiation, a 1.2-7-fold increase was observed in fly sensitivity to the insecticides, depending on the dose of irradiation. (CA 65: 1966, 14072e)

1170 Vashkov, V.I., Poleshuk, V.D. THE EFFECT OF x-IRRADIATION ON INSECT SENSITIVITY TO INSECTICIDES. Zh. Mikrobiol. Épidem. Immunobiol. 8 (1966) 9-11. (In Russian, with English summary)

The effect of x-irradiation on the sensitivity to DDT, hexachlorane and chlorophos was studied on 5-d-old domestic flies (female). Fly susceptibility to insecticides varied, depending on the x-ray dose absorbed. Following irradiation there was an increase in chlorophos sensitivity by a factor of 1.2-6, to hexachlorane of 1.2-9, and to DDT of 1.2-7 as compared with controls. Max. fly sensitivity to insecticides was observed after a particular dose: for hexachlorane - 10 000 rad, DDT - 30 000 rad, and chlorophos - 40 000 rad.

1171 Ware, G.W., Guenthner, A.W. EFFECTS OF x-IRRADIATION ON TOXICITY OF INSECTICIDES. Bull. ent. Soc. Am. 12 (1966) 252. Abstr. 33, at "Portland Meeting, Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

Female flies from irradiated pupae were highly tolerant to malathion with no change in males. The opposite was found with Temik®. Irradiated adults showed no change in tolerance to heptachlor and malathion, but susceptibility to Temik increased greatly in both sexes. (Abstr.)

1172 Wood, R.J. RESPONSE OF INSECTS TO RADIATION. p.2 of "Pacific Northwest Laboratory Monthly Activities Report, July 1966, on AEC Division of Biology and Medicine Programs". BNWL-304, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab", Aug. 1966, 16p.

A data analysis was continued relative to deducing the genetic bases for changes in flour beetles grown under the influence of DDT and x-irradiation.

See also :

1159 Effect of host eggs derived from irradiated pupae of the sugarcane borer on Trichogramma parasitism. (Yoshimeki, M. et al., 1967)

1410 Modification of fitness in species and strains of flour beetles due to x-ray and DDT. (Erdman, H.E., 1966)

1443 Effect of gamma radiation on the larvae and the nuclear-polyhedrosis virus of the Eastern tent caterpillar, Malacosoma americanum. (Smirnoff, W.A., 1967)

1501 Some new mutants of the house fly, Musca domestica, with notations of related phenomena. (Hoyer, R.F., 1966)

1538 Prospects of integrated microbial and radiation control of harmful insects. (Jafri, R.H., 1967)

2.1.8. Tumour Induction

1173 Baroche, C. POTASSIUM PHTHALATE AND TUMOR DEVELOPMENT IN Drosophila. II. Bull. Ass. fr. Étude Cancer 52, 3 (1965) 255-166. (In French)

K phthalate (I) (0.625-35 mg/ml diet) o-phthalic acid (5 mg/ml), or fluorescein (10 mg/ml) suppressed the incidence of tumours in Drosophila strain cl tu (melanic-tumour sensitive) imagos when fed to the larvae; a linear relation was shown between the probit of normal insects and the logarithm of the I concentration of the medium. However, treatment increased tumour incidence in the untreated offspring of treated parents; the incidence increased as a function of the number of treated parental generations, remained at a stable level ≤30 generations, and was irreversible. The offspring remained sensitive to I throughout the 30 generations. The effects of x-irradiation were examined: I suppressed the tumour-inducing effects of x-irradiation (600 R) of 24-h-old 1st generation larvae maintained on a medium containing I. A linear relation was shown between the probit of the level of normal insects and the log of the I concentration. However, x-irradiation diminished the sensitivity of the strain to I; in non-irradiated and irradiated insects, 1.62 mg and 10.2 mgl/ml respectively, inhibited tumour formation in 50% of the insects. The effects of I on the descendents of these flies were similar to those in non-irradiated insects. The inhibitory action of I on tumour formation is due to its toxic effect and is active at the physiological level of tumour development; its action on tumour development in descendents of treated insects involves hereditary mechanisms. (CA 64: 1966, 20288c)

1174 Brooks, G.T. EFFECTS OF X-RAYS, TRYPTOPHAN METABOLITES, AND EYE COLOR MUTANTS ON THE TUMOR-SUPPRESSOR SYSTEM IN Drosophila melanogaster. Diss. Abstr. 27, 12 Pt.I (1967) 4597-B.

Four stocks of D. melanogaster incorporating different combinations of tumour alleles on the II chromosome and tumour-suppressor alleles on the III chromosome were submitted to 1000 R of x-rays, dietary manipulations, and mutant eye colour gene substitutions in order to test the influence of x-ray action and tryptophan metabolism on the induction of melanotic tumours in 3rd-instar larvae. There was no significant difference between tumour incidence resulting from x-ray treatment in air and that resulting from x-ray treatment in 100% O_2; but both treatments produced a significant increase in tumour penetrance over control incidence for each of the four parent stocks: suppressor-erupt (tu; su-tu), al b c sp^2(tu^+; su-tu^+), tumour (tu; su-tu^+), and erupt (tu^{er}; su-tu). Comparisons of tumour incidence in parent stocks, F_1 progenies, and certain backcross progenies revealed the existence of effective isoalleles of varying potency at both the tumour and tumour-suppressor loci. The tu^+ and su-tu^+ alleles, previously assumed to be ineffective wild-type alleles, are, in actuality, weakly effective alleles. The results indicate that a dominance relationship exists among the three tumour alleles such that the order of dominance is $tu^+ > tu^{er} > tu$, while the effectiveness in producing the tumour phenotype is just the reverse: $tu > tu^{er} > tu^+$. Of the two suppressor alleles, su-tu^+, seems to be dominant over su-tu, which is a much stronger suppressor than the former. The su-tu allele appears to act as a recessive in the presence of homozygous tu, while the su-tu/su-tu^+ combination is quite effective in suppressing the tumour phenotype produced by weaker tumour allele combinations. The increase in tumour incidence following x-ray treatment is attributed to a dual action of x-rays: enhancement of the expression of the tumour gene and inhibition of the expression of the tumour-suppressor gene. It was further postulated that x-ray action has a differential effect according to the potency of alleles present at the two loci. (From DA)

See also :

31 Effets tumorigènes de la leucine, de l'uridine et de la thymidine tritiées chez les larves de la drosophile. (Chelelovitch, S., 1966)

1263 The action of radiation and other mutagenic agents, 1. in inducing mutation in Drosophila females, and 2. in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, H.B., 1966)

2.1.9. Modifying Factors
(Intensity. Mode of Irradiation. Ploidy. RBE. LET. Temperature. Synergists. Chemicals including Protective Agents. Environment at Irradiation. Medium. Irradiated Molecules. Etc.)

1175 Abeleva, E.A. INFLUENCE OF ARGININE OF RADIATION DAMAGE OF SPERMATIDS AND SPERMATOCYTES IN Drosophila. Genetika No.6 (1965) 115-119. (In Russian)

The effects of arginine on spermatogenesis were investigated in γ-irradiated (1000 or 1500 R) D. melanogaster males. The crossing-over frequency was determined in the F_1 progeny of irradiated males crossed with virgin females. Neither the time nor the frequency of crossing-over were affected by arginine. Comparison of fertility curves of males both exposed and unexposed to arginine treatment suggested that arginine either removes or reduces the radioinduced delay of spermatogenesis. Protective actions of arginine were further shown to be very versatile. (NSA 20 : 1966, 22780)

1176 Abeleva, E.A. INFLUENCE OF 2,4-DINITROPHENOL (DNP) ON MUTATION FREQUENCY IN SPERM CELLS AND SPERMATIDS OF Drosophila IRRADIATED WITH GAMMA RAYS. Genetika No.1 (1966) 116-118. (In Russian)

Studies showed that DNP treatment decreases frequency of recessive sex linked lethal mutations in γ-irradiated Drosophila spermatids at a dose of 1000 R. It is significant that in sperm cells of the same flies mutation frequency did not change. (NSA 20 : 1966, 33079)

1177 Abeleva, E.A. NORMALIZING EFFECT OF ARGININE ON THE RELATION BETWEEN THE IONIZING RADIATION DOSE AND THE FREQUENCY OF MUTATION GENERATION IN Drosophila SPERMATIDS. p.209-219 of "Vliyanie Ionizirovannykh Izluchenii na Nasledstvennost". Dubinin, N.P., Ed. Moscow, Izdatel'stvo Nauka, 1966. (In Russian)

The effect of arginine (I) on the frequency of mutation generation was studied in Drosophila spermatids. Drops (5-6) of I solution (2 mg of I/ml water) were added to medium containing larvae of Drosophila D-18. The males born from these larvae (1.5 to 2 d old) were γ-irradiated with 1-3 kR (dose rate 326 R/min), and individually mated with five virgin females every day for 7 d. Mutation frequency and fertility of the males were determined. A bell-like form of the curve of frequency of mutations as a function of the irradiation dose was found in medium spermatids (5 d). Mean fertility was one descendant/male/d at this time interval, after the irradiation with 3 kR. Max. frequency of mutations following irradiation with 3 kR was noted in the late spermatids (4 d). Then it decreased together with the fertility (on the 7th day 0.3 descendant/male/d.). In males treated with I during the larval state the max. frequency of mutations was observed on the 5th day. A higher percentage of mutations together with about 2 times greater fertility was observed on the 5 - 7th day in males treated with I, in comparison with irradiated controls. The linear dependence of mutation frequency on the dose was observed in experiments with I. Possible mechanisms of I action on the radiation mutagenesis were discussed. (CA 67:1967, 8487r)

1178 Alexander, M.L. DIMETHYL SULFOXIDE TREATMENT OF Drosophila. p.505-516 of "Studies in Genetics. III." Wheeler, M.R., Ed. Austin, Tex., University of Texas, 1966.

An investigation of the effect of dimethyl sulfoxide on radioinduced genetic damage in adult male D. melanogaster is described. Young adult male abdomens were dipped in concentrated dimethyl sulfoxide and exposed to x-ray doses of 4213, 1674, and 2000 R 4 to 5 h later. Others were injected with .0004 ml of a 10^{-1} M solution of dimethyl sulfoxide 4 to 5 h before exposure to a 2000-R x-ray dose. Others were developed from eggs on a diet supplemented with 0.5% dimethyl sulfoxide before exposure to a 2000-R x-ray dose. Genetic damage was evaluated by measuring dominant lethals, translocations, or sex-linked recessive lethals after mating treated males. None of the chemical treatments protected against radioinduced genetic damage. It is suggested that the 4-h period between chemical treatment and irradiation may be too long for the detection of radioprotective effects. (From NSA 21:1967, 34690)

1179 Antipov, V.V., Arsenyeva, M.A., Davydov, B.I., Delone, N.L., Lifshitz, N.N., Saksonov, P.P., Parfenov, G.P., Rybakov, N.I. INVESTIGATION OF THE COMPLEX EFFECT OF IONIZING RADIATION AND OTHER FACTORS OF SPACE FLIGHT ON THE ORGANISM. p.23 of "3rd International Congress of Radiation Research, Cortina d'Ampezzo, 26 Jun.-2 Jul. 1966, 263p." Abstr. 87.

The effect of complex factors of space flight on some functions of different organisms is considered. In experiments with fruit flies, vibration after and acceleration before irradiation enhances the radiation effect. A decrease in the rate of crossing-over was observed when vibration was used before radiation. (From abstr.)

1180 Antipov, V.V., Delone, N.L., Parfenov, G.P., Vysotskiy, V.G. RESULTS OF BIOLOGICAL INVESTIGATIONS CONDUCTED DURING FLIGHTS OF "VOSTOK" TYPE VEHICLES WITH THE PARTICIPATION OF COSMONAUTS A.G. NIKOLAYEV, P.R. POPOVICH, AND V.F. BYKOVSKIY. p.239-251 of "Problems of Space Biology, Vol.4, 1966", N66-19292, National Aeronautics and Space Administration, Washington, D.C.

Results are presented for experiments dealing with the reproductive processes in Drosophila melanogaster under conditions of weightlessness, and the study of space flight factors which affect the hereditary structure in Tradescantia paludosa. The hypothesis is advanced that chromosome rearrangements result from dynamic factors occurring during lift-off and descent of the spacecraft, and that weightlessness does not cause such rearrangements. The data do not eliminate, however, the possibility that weightlessness may cause disruptions of the mitotic mechanism. Also observed were the formation of excrescences in cells, giant cells and disrupted synchrony of microspore development, but the individual flight factors causing these cannot be determined. Experiments with the flies indicated that breeding time was increased from the usual 9 to 15 d for eggs laid during weightlessness. More females were hatched than males, and several ideas are advanced to explain this, including space travel effects on Y-chromosomes utility, a loss of Y-chromosomes during meiosis, or that the female larvae were more fit. (Scient. A. Techn. Aerospace Repts.)

1181 Asman, S.M., Rai, K.S. GAMMA RADIATION AND HETEROSIS IN Aedes aegypti. Bull. ent. Soc. Am. 13, 3 (1967) 201, Abstr. 310, at "New York Meeting of the Entomological Society of America, New York, N.Y., USA, 27-30 Nov. 1967".

Hybrid lines of A. aegypti demonstrate heterosis in their greater tolerance to the deleterious effects of ionizing radiation. Data also suggest that hybrid vigour can result in highly inbred strains by the induction of polygenic mutations using low doses of radiation. (Abstr.)

1182 Borstel, R.C., von. MUTAGENIC EFFECTIVENESS OF KNOWN DOSES OF GAMMA RADIATION IN COMBINATION WITH WEIGHTLESSNESS OF Habrobracon. Summary Progress Report, February 17, 1964 - June 30, 1966, ORNL-TM-1731, Oak Ridge National Lab., Tenn. Mar.1967, 26p.

Progress is reported on the following studies: preparation of the Habrobracon stocks for the biosatellite experiment; biosatellite preparatory experiments; spontaneous mutation frequencies in Habrobracon; Habrobracon experiments in simulated space-flight tests; x-radiation sensitivity of Habrobracon oocytes at diakinesis; time of death of a translocation segregant in Habrobracon; and x-ray induction of mutations in Habrobracon. (NSA 21: 1967, 22375)

1183 Borstel, R.C., von. MUTAGENIC EFFECTIVENESS OF KNOWN DOSES OF GAMMA RADIATION IN COMBINATION WITH WEIGHTLESSNESS ON Habrobracon. Quarterly Progress Report to the National Aeronautics and Space Administration, July 1 - September 30, 1966. ORNL-TM-1782, Oak Ridge National Lab., Tenn. Mar.1967, 42p.

The report lists the types of genetic and cellular damage assayed in Habrobracon and the method of data analysis. The results of the Ames Research Center Biocompatibility Test are described, the radiation conditions surrounding the Habrobracon in the ARC Test, and the result of the Flight Vehicle Tests at General Electric Company. Some of the supporting experiments are reported, which are required continuously to keep improving the experimental system. A discussion is included that provides a theoretical foundation for the Habrobracon dominant lethality data that will come from the ground control for the Biosatellite experiment.

1184 Burditt, W.J., Yoon, J.S. EFFECTS OF ECDYSONES ON FREQUENCY AND DISTRIBUTION OF x-RAY INDUCED LETHALS IN Drosophila melanogaster. Genetics 56, 3 Pt.2 (1967) 547-548. Presented at the "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

The possible alteration by hormonal action of the frequency and distribution of mutations induced by radiation was tested in a large series of experiments, utilizing ecdysones as hormone and lethal mutations on the X-chromosome as the indicator. Males were treated with ecdysones 20 min before radiation with a dose of 3000 R (140 kV and 5 ma) with and without oxygen. The data suggest that ecdysones may protect against genetic radiation damage in the presence of oxygen. When the 294 lethals obtained were localized by crossover analysis, no significant difference in the distribution ($P < 0.01$) of lethals along the X-chromosome in groups treated with and without ecdysones was found. (Abstr.)

1185 Close, P., Beischer, D.E. EXPERIMENTS WITH Drosophila melanogaster IN MAGNETIC FIELDS. AD-404251, Naval School of Aviation Medicine, Pensacola, Fla., 1 Aug. 1962, 10p.

No genetic effects were observed in Drosophila on exposure to homogeneous and inhomogeneous magnetic fields of high field strength and gradient. Synergistic effects of magnetic fields in combination with x-radiation, starvation, hyperoxia, and hypoxia were also not observed. (Auth.)

1186 Dauch, F., Apitzsch, U., Catsch, A., Zimmer, K.G. RBE OF FAST NEUTRONS BY THE RELEASE OF MUTATIONS IN Drosophila melanogaster. Mutation Res. 3 (1966) 185-193. (In German)

The RBE of fast neutrons (as compared with x-rays) was determined in D. melanogaster for various broods (stages of germ cells) and for sex-linked recessive lethals as well as for translocations between IInd and IIIrd-chromosome. A pronounced dependence of RBE on the stage of the germ cells was shown to occur and to account for most of the discrepancies reported in earlier work. Moreover, the RBE was demonstrated to be lower for recessive lethals than for translocations at all stages of spermatogenesis tested. These findings are discussed briefly as to their implications for problems of protection from radiation damage. (Auth.)

1187 Delahaye, R.P., Tabusse, E. SPACE REPORT. EXTRATERRESTRIAL RADIATIONS. I. BIOLOGICAL STUDIES. Revue Méd. Aéronautique 3 (1964) 593-597.

The authors review the findings and results of biological studies which bear upon the biological effects of extraterrestrial radiations. The four types of extraterrestrial radiations include galactic cosmic radiations, solar cosmic radiations, radiation of the Van Allen belt, and interplanetary plasma. The composition of these radiation areas is fairly well known. A wide variety of experimental animals and plants have been tested for radiobiological effects. These include mammals such as dogs, guinea pigs, rats, and pigs, Drosophila, grains and vegetables, Chlorella, microbiological samples, and DNA. Estimates of the relative biological effectiveness of radiations encountered have been made. Many of these measurements have been made below sea level, as well as at sea level, during balloon flights, or in satellites.

1188 Dickerman, R.C. FAST NEUTRON AND x-RAY IRRADIATION OF Drosophila melanogaster OOGONIA AND OOCYTES. Genetics 56, 3 Pt.2 (1967) 555-556. Also presented at "1967 Meetings of the Genetics Society of America. Stanford, Calif., 31 Aug.-2 Sep. 1967".

Female D. melanogaster were irradiated either with fast neutrons (0.2-0.3 MeV) from the Janus reactor of this Division or with x-rays. Oogonia and stage 7 oocytes were sampled from females irradiated when they were 0 - 4 h old. Virgin females were irradiated when they were 3 d old to provide both stage 14 oocytes and oogonia. The flies were exposed to x-ray doses of 960, 1920, 2880, and 3840 R (250 kVp, 30 ma, with 0.25 mm Cu plus 1.0 mm Al filtration, 155 rad/min). Neutron irradiations of 267, 533, and 1066 rad (at 45 rad/min) were performed on the central axis of, and 1 m from, the high flux face of the reactor. The γ-contribution averaged 8.7% of the neutron dose. Egg-to-adult viability and the induction of sex-linked recessive lethals were the end points. The oogonial stage is the least sensitive stage. Since an oogonial cell must undergo four synchronous mitotic divisions before becoming an oocyte, cell selection at this stage is rigorous. Stage 7 oocytes are intermediate in radiation sensitivity since they are metabolic-

ally active and some repair of chromosomal damage is possible. Stage 14 oocytes (mature eggs) are most sensitive to radiation damage because of their low metabolic rate and lack of cell selection processes. In terms of egg-to-adult viability, the neutrons used produce damage about three times more effectively than x-rays of similar doses. In the sex-linked lethal tests, neutrons were more effective than x-rays by a factor of < 2. (Abstr.)

1189 Dickerman, R.C. MUTATIONAL RESPONSE OF Drosophila melanogaster OOCYTES AND OOGONIA TO x-RAY AND FAST NEUTRON IRRADIATION. Radiat. Res. 31, 3 (1967) 614. Abstr. Eb-7, at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Female 0-4 h old D. melanogaster were irradiated with either fast neutrons from the Janus Reactor or x-rays. The flies were exposed to x-ray doses of 960, 1920, 2880, and 3840 rad (250 kVp, 30 mA, with 0.25-mm Cu plus 1.0-mm Al filtration, 155 rad/min). Neutron irradiations of 267, 533, 800, and 1066 rad (at 45 rad/min) were performed on the central axis of, and 1 m from, the high-flux face of the Reactor. The neutrons have a mean energy of 0.2-0.3 MeV. The γ-contribution averaged 8.7% of the neutron dose. The end points studied were egg-to-adult viability and sex-linked recessive lethals induced in oogonia or Stage 7 oocytes. The data illustrates the role of cell repair versus cell selection on the ultimate expression of damage after irradiation by photons or neutrons. Oogonial cells, irradiated with x-rays, are damaged least; this suggests both effective cell selection and repair. Stage 7 oocytes, irradiated with neutrons are damaged most since there is little opportunity for cell selection; preliminary data indicate there is little or no repair in this stage. Oogonia, irradiated with neutrons, undergo rigorous cell selection and probably little repair, while x-irradiated Stage 7 oocytes undergo repair but show no selection. Hence, these latter two experimental groups exhibit damage intermediate between the low level seen in x-irradiated oogonia and the large amount of damage seen in neutron-irradiated oocytes. (Abstr.)

1190 Elequin, F.T., Yang, H.L., Yoon, J.S., Gerstenberg, V., Wilson, F., Stone, W.S. "Research in Genetics to Include: (1) The Direct and Indirect Effects of Radiations and their Modification on Genetic Systems, and (2) Population and Evolutionary Studies of Drosophila". Stone, W.C., comp. Final Report, 1 Jan. 1962 - 31 Dec. 1965. TID-23414, Texas Univ., Austin. 18p.

O_2 during irradiation increases net radiation damage above that found if radiation is carried out in an inert gas such as Ar. The data do not support a role of O_2 in healing genetic damage during intervals between radiation in Drosophila melanogaster, except in special conditions. Irradiation of 1000 R in nitric oxide does not increase or reduce genetic damage measured as translocations from that found in Ar. Irradiation of 3000 R in CO in the dark is similar to irradiating in Ar. The CO can be replaced with He, O_2, NO or CO+NO during the interval between the two 1500 R-radiations without changing the effect. Various sets of experiments are described and discussed. The results of comparisons of the rates of translocations and recessive lethals are tabulated. The relative frequency (translocations/recessive lethals) is higher in the more susceptible spermatid stages. It is also higher in experiments where more radiation damage was produced by a higher dose of radiation or the presence of O_2. At 3000 and 1000 R, the influence of cell sensitivity and environmental variables on recessive lethals is seen.

1191 Elequin, F.T. MODIFICATION OF INDUCED GENETIC DAMAGE IN Drosophila melanogaster BY OXYGEN AND ARGON TREATMENTS BETWEEN TWO DOSES OF x-RAYS. p.177-193 of "Studies in Genetics. III." Wheeler, M.R., Ed. Austin, Tex., University of Texas, 1966.

D. melanogaster males were x-rayed with two equal doses of either 500 or 1500 R separated by 20 min. They were irradiated in either O_2 or Ar at 1 atm. During the 20 min intervals flies were kept in O_2 or Ar. They were pretreated in the gases for 10 min and post-treated for 20 min. Each male was mated within an hour after treatment and remated every 2 d for 7 consecutive matings. The offspring carried chromosomes irradiated at different stages of spermatogenesis. Chromosome damage was measured by tests for sex-linked recessive lethals, dominant lethals, and translocations. When irradiated in O_2 the damage was greater in the spermatid stage if the flies were in Ar rather than O_2 in the interval between irradiations. When irradiated in Ar no significant difference was found in the degree of damage if the flies were in Ar or O_2 during the interval when the test was for sex-linked recessive lethals or translocations. The dominant lethal tests gave different results which are discussed. In O_2 radiosensitivity was at a peak during the

spermatid and meiotic stages. In Ar a differential response was less obvious. The Y-chromosome was involved in less than half the total translocations and showed no autosome preference. Chromosomes II and III were about equally affected by irradiation. (NSA 21: 1967, 34635)

1192 Erdman, H.E. EFFECTS OF DIMETHYL SULFOXIDE (DMSO) ON PRODUCTIVITY OF X-RAYED FLOUR BEETLES. Radiat. Res. 25 (1965) 186. Abstr.41, at "13th Annual Meeting of the Radiation Research Society, Philadelphia, Pa., USA, 23-26 May 1965".

The degree of injury to biological systems subjected to irradiations depends on the chemical as well as the physical environment. Radioprotection is known for sulfhydral and sulfoxide compounds, although data on the latter are meagre. Germ cells are the predominantly actively dividing cells in adult insects; consequently, they are readily modified by radiation. Radiation increases the frequencies of chromosomal aberrations which may lead to illness or death and which may be modified by chemical protection. Sexually mature virgin female flour beetles, Tribolium castaneum (mutant: sooty), were treated in different ways to various concentrations of DMSO and then x-rayed with 0, .5, 1, 2, and 4 kR. Survival and productivity data (fecundity and fertility) were collected. DMSO gave no radiation protection to x-rayed female germ cells whether fecundity or fertility was scored. Radiation at different time intervals after DMSO treatment was also ineffective. When females were cultured for 4 d on 100 g of dry food previously mixed with 10 cc DMSO and then placed on regular food, their reproduction began on the 3rd day. Under similar conditions but with 5 cc DMSO, productivity began on day 2. Controls reproduced on day 1. In both DMSO fed groups productivity was reduced compared to the controls. This experiment was repeated and a cytological description of the ovarioles will be presented to show the ovicidal effect of DMSO. (Abstr.)

1193 Goldman, L.J., Saluk, P.H., Cromroy, H.L. NITROGEN EFFECT IN IRRADIATED Periplaneta america. Bull. ent. Soc. Am. 13, 3 (1967) 192, Abstr.112, at "New York Meeting of the Entomological Society of America, New York, N.Y., USA, 27-30 Nov. 1967".

A strain of P. americana was exposed to a determined LD 50/24 h dose of 300 kVp x-rays to study the protective effect of N. The strain used initially demonstrated potentation rather than protection. A 2nd strain showed the reverse effect. (Abstr.)

1194 Havin, E., Oftedal, P. RADIOSENSITIVITY OF Drosophila EMBRYOS IN AIR AND IN N_2, IN RELATION TO AGE. Radiat. Res. 25, 1 (1965) 196, Abstr.66, at "13th Annual Meeting of the Radiation Research Society, Philadelphia, Pa., USA, 23-26 May 1965".

D. melanogaster embryos show great changes in radiosensitivity with age. These changes occur during a period of rapid morphological development. It appeared possible that the relative importance of difference mechanisms of radiation injury might vary with age, leading to variations in the O enhancement ratio. Eggs were collected during 10 min periods, and x-rayed (200 keV, 0.5 Cu + 1 Al filter) in air at 14 stages between 1,0 and 3.5 h. Exposure time was 6 min in all experiments. The dose-effect curve for each age was determined with regard to hatching from the egg. Normal hatching time is 19.2 h. Counts were made at 17 h to eliminate early hatchers, and at 40 h to score non-hatchers. A stage of high radiosensitivity was found at 1.5-2 h, and a peak of low radiosensitivity at 2,7 h. The LD 50's are 186 R and 1670 R respectively. Subsequently, embryos at ages 1 h 38' and 2 h 38' were irradiated in air, or given 1 min N_2 pretreatment and then irradiated in N_2. The dose-effect curves obtained in four such series indicate that the O enhancement ratios at the LD 30, LD 50 and LD 70 levels were from 2.0-2.3, with no systematic trend. Thus, no difference in mechanism of radiation injury could be demonstrated by this method, in spite of the 9-fold difference in radiosensitivity between the stages investigated. (Abstr.)

1195 Hossain, M.M., Mollah, S.A., Mallik, M.U. STUDIES ON THE EXPERIMENTAL POPULATION OF Drosophila melanogaster RAISED ON IRRADIATED BANANA DIET. AECD-RB-4, Atomic Energy Centre, Dacca (Pakistan), Nov. 1966, 7p.

For abstract, see 1196.

1196 Hossain, M.M., Mollah, S.A., Mallik, M.U. STUDIES ON AN EXPERIMENTAL POPULATION OF Drosophila melanogaster RAISED ON IRRADIATED BANANA DIET. Fd Irrad. 7, 3 (1967) 45-48.

Seven generations were fed irradiated banana diet. Bananas treated with 35 000, 45 000, and 55 000 rad were compared with untreated bananas in terms of their effect on egg-pupa ratio, percent adult emergence, longevity, egg-production, and viability in order to assess possible toxicity or changes in nutritive value, or mutagenic effects. In fertility tests 2500 flies were tested for each series. No case of sterility was observed. No effects were found which could be attributed to irradiated food.

1197 Khan, A.H., Alderson, T. AN ATTEMPT TO SENSITIZE Drosophila CHROMOSOMES TO x IRRADIATION AFTER 5-BROMODEOXYURIDINE INCORPORATION INTO DNA. Drosoph. Inf. Serv. 41 (1966) 135-136.

Substitution of 5-bromodeoxyuridine (BdU) for thymine in DNA enhances the sensitivity of cells to x-irradiation. Using an aseptic and chemically defined culture medium, the radiosensitivity (for sex-linked recessive lethal mutations) of chromosomes of Drosophila larval spermatogonia was compared in the presence and in the absence of BdU. Drosophila does not utilize pyrimidine bases unless they are supplied as the nucleoside. To increase the chance of BdU incorporation, larvae were cultured in the presence of the folic acid analogue, aminopterin, which inhibits thymine synthesis. A dose of 810 R of x-rays was delivered at 180 R/min. Males and females were examined for sex-linked recessive lethals by the Muller-5 method using a single brood by mating individual males to two virgin females for 3 d, and, in the case of females, by mating individual females to two males for 3 d. When larvae were cultured in the presence of either deoxyuridine or BdU for 48 h (with and without aminopterin), and followed by irradiation, or without irradiation, none of the sex-linked recessive lethal frequencies differed significantly from one another. There was no evidence for BdU-induced mutagenesis; and only a slight increase in mutation following x-irradiation of males. There was no evidence for an increase in mutational radiosensitization of the X-chromosome in the presence of BdU, nor was there evidence for BdU incorporation, although the BdU + aminopterin cultures slowed down larval development compared with the deoxyuridine + aminopterin cultures. (NSA 21;1967, 22707)

1198 Kogan, Z.M. OCCURRENCE OF LETHAL MUTATIONS IN THE HETEROCHROMATINIC REGION OF Drosophila melanogaster X CHROMOSOME DEPENDING ON PRERADIATIONAL DEVELOPMENT TEMPERATURE. Genetika No.4 (1966) 38-44. (In Russian)

D. melanogaster males reared at 15°C (cold series) and at 28°C (warm series), respectively, were x-irradiated (at a dose of 6000 R). Subsequent crosses were carried out at 25°C. It was found that lethal mutation induction percentage in the heterochromatinic X-chromosome region (at the locus bobbed) was twice as high in the ripe sperm cells of the cold series in contrast to that of the warm series. Recessive sex-linked lethal and dominant sterility mutations also occurred more often at a lower development temperature though the difference between the temperature series in this case was far lower. In both temperature series a decrement of mutation frequency in spermatids in contrast to ripe sperm cells was observed. The decrement was highly tressed for bb^1 in dominant sterility mutants and was far less manifest for recessive sex-linked lethals. (Auth.)

1199 Kondo, S. RBE OF FAST NEUTRONS TO γ-RAYS FOR MUTATIONS IN RELATION TO REPAIR MECHANISMS. Idengaku Zasshi (Jap. J. Genet.) Suppl. 40 (1965) 97-106. (In English) "Proceedings of the Conference on Mechanisms of the Dose Rate Effect of Radiation at the Genetic and Cellular Levels. Ôiso, 4-7 Nov. 1964". The Genetics Society of Japan. 1965, 280p.

A brief review of RBE for somatic and genetic damage is given for various organisms. A brief summary is given concerning comparative studies of mutation frequencies with silkworm irradiated with γ-rays, 14 MeV neutrons and fission neutrons. From the analysis of the silkworm data combined with the above mentioned review of RBE data for other organisms, the following hypotheses are proposed: (1) the overall mutation frequency in silkworm gonia depends on the interaction of radiation with the intercellular repair mechanisms connected with certain multicellular organs, and (2) the low mutation rate recovered on acute γ-irradiation of silkworm larvae of the late gonial stage is due to stimulation of repair by radiation. (Auth. summary)

1200 Leuthold, U. FÜTTERUNG VON STRAHLENSENSIBILISIERENDEN STOFFEN AN Drosophila. (The feeding of radiation-sensitizing substances to Drosophila.) Thesis, Eidgenoessische Technische Hochschule, Zurich (Switzerland). 1966. (In German)

1201 Magdon, E., Winterfeld, G. INVESTIGATIONS ON THE INFLUENCE OF 5-BROMOURACILDESOXYRIBOSIDE (BUdR) ON THE RADIOINDUCED MUTATION RATE IN Drosophila melanogaster. Strahlentherapie 133 (1967) 137-148. (In German, with English summary)

Using male D. melanogaster of the Berlin wild strain, the effect of 5-bromo-2'-deoxyuridine (BUdR) on the x-radioinduced rate of recessive and sex-linked lethal factors was investigated in different stages of spermatogenesis. It was shown that the mutation rate induced by irradiation with 1500 R was significantly increased in spermatogonia, when BUdR was given after irradiation; BUdR was not effective in sperm when administered prior to irradiation. A possible explanation seemed to be that BUdR incorporation into the DNA, sufficient for a significant increase of the radioinduced mutation rate, was possible only in germ cells that synthesize DNA, and after a radiation induced inhibition of the thymidylate synthesis. (Auth.)

1202 Matter, B. WIRKUNG VON H_2S AUF BESTRAHLTE UND UNBESTRAHLTE EIER VON Drosophila melanogaster. (The effect of H_2S on irradiated and non-irradiated eggs of Drosophila melanogaster.) Thesis, Eidgenoessische Technische Hochschule, Zurich (Switzerland). 1966. (In German)

1203 Mittler, S. AET AND RADIATION INDUCED CROSSING-OVER IN MALE D. melanogaster. Drosoph. Inf. Serv. 40 (1965) 93.

A re-examination of the problem (Mittler and Hampel, Drosoph. Inf. Serv. 38) of whether AET has any effect upon radiation induced crossing-over in male D. melanogaster indicates that AET does afford significant protection to 9-12-d brood after irradiation. Adult males, 2-16 h old, heterozygous for ru h th st cu sr e^s ca, were injected with 1×10^{-7} l of 30 mg AET/10 ml buffered to pH of 7 and irradiated with 2000 R and then back-crossed to homozygous "rucuca" females at ratio of one male to three females. The males were transferred to new group of females every 3 d.

Number Males	9-12-d brood			12-15-d brood		
	Crossover	Non	% Crossover	Crossover	Non	% Crossover
120 Treated	57	8502	.666	54	11361	.473
101 Control	49	5025	.966	29	4187	.688

(Auth.)

1204 Mittler, S. AET AND RADIATION-INDUCED CROSSING-OVER IN MALE Drosophila melanogaster. Biol. Bull. 130, 2 (1966) 228-234.

Drosophila, heterozygous in the IIIrd chromosome for the traits roughoid, hairy, thread, scarlet, curled, stripe, ebony, and claret were injected with 3.33×10^{-5} mg of AET, irradiated with 2000 R x-ray and back-crossed to virgin flies. The controls were injected with saline. On the 9th day after irradiation, each male was isolated and mated again. This was repeated on the 12th day. There was a significant decrease in the number of γ_2-type cross-overs (0.568%) in the older spermatogonia represented by the 9-12-d brood, compared to the controls (0.886%). No decrease was found in the early spermatogonia represented by the 12-15-d brood. The chromosomal breakage was mainly between scarlet and curled and included the centromere. AET did not influence the region of breakage. Post-treatment with N reduced the number of radiation-induced cross-overs in the controls to the level in the flies treated with AET. N post-treatment was without effect on those treated with AET. AET appeared to protect Drosophila against x-rays by inducing anoxia. (CA 65:1966, 4233d)

1205 Mittler, S., U, R. MODIFICATION OF RADIATION INDUCED CHROMOSOME LOSS BY ATP IN Drosophila. p.157 of "3rd International Congress of Radiation Research, Cortina d'Ampezzo, Italy, 26 Jun.-2 Jul, 1966, 2630". Abstr.622.

Male Drosophila melanogaster, 2-16 h old, $X^{C2}yB$, $Ysc^{S}y^{+}$ were irradiated with 2000 R of x-rays and then mated daily to ywf females at the ratio of one male to three females. The loss of the ring X-chromosome or the y^{+} portion of Y resulted in the exceptional (XO) ywf male. Injection of 1×10^{-5} ml of 5 mg of ATP/ml in 0.85% NaCl per male fly either immediately before or after radiation resulted in a significant reduction in the percentage of XO males in certain broods. Those broods (days 7-8, 8-9, 9-10) which primarily represent cells in spermatogenesis that were in or about to go into meiosis at the time of radiation had less XO males and thus less chromosome loss as a result of pre-treatment with ATP. Post-treatment with ATP resulted in significantly less XO males in brood 7-8 d. There was no significant reduction of XO males due to ATP treatment in the postmeiotic broods days 1-4 and in the broods 10-12 d, which represent spermatogonia at the time of irradiation. It appears that exogenous ATP does aid in repair of radiation injured chromosomes at meiosis and prevents their loss. (Abstr.)

1206 Mittler, S., Arnesen, J.F., U, R. EFFECT OF URETHANE AND COLCHICINE ON RADIATION-INDUCED CHROMOSOME LOSS IN MALE Drosophila. Int. J. Radiat. Biol. 11 (1966) 161-170. (With French and German summaries)

Urethane or colchicine was injected, either before or immediately after 2000 R of x-rays, into male D. melanogaster. Urethane modified the radiation-induced loss of the ring X or Y sc^{S} y^{+} chromosome, as determined by the number of XO male offspring. Urethane alone increased the loss of the ring X-chromosome primarily in the mature spermatozoa and older spermatids, whereas x-rays induced chromosome loss to a greater extent in those cells in or about meiosis. Pre-treatment or post-treatment with colchicine by means of injection near the testis gave an apparent protection against radiation-induced chromosome loss; but colchicine alone induced sterility by reducing the number of gametes available to form zygotes by affecting those cells in spermatogenesis that were in or about meiosis at the time of treatment. (Auth.)

1207 Mittler, S., U, R. ADENOSINE TRIPHOSPHATE: PROTECTION AGAINST RADIATION-INDUCED CHROMOSOME LOSS IN Drosophila. Science, N.Y. 152 (1966) 1087-1088.

Injection of 5 mg of adenosine triphosphate per milliliter into adult D. melanogaster $X^{C2}yB/sc^{S}y^{+}$ 4-8 h old either immediately before or after administration of 2000 R of x-rays protected those cells in spermatogenesis which were in or near meiosis from the loss of the ring X or the y^{+} portion of Y-chromosome. The loss of the chromosomes was determined by appearance of exceptional XO males in the offspring. (Auth.)

1208 Mittler, S., Walsh, M.M. EFFECT OF ATP UPON RADIATION INDUCED CHROMOSOMAL ABERRATIONS IN Drosophila. Genetics 56, 3 Pt.2 (1967) 577-578. Also presented at "1967 Meetings of the Genetics Society of America, Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

ATP at concentration of 5 mg/ml was injected (0.1 µl) near the testis of adult Drosophila 2-6 h old prior to exposure of 1600 R of x-rays. The males were mated daily to a new group of virgin females at ratio one male to three females. This treatment did reduce the number of dominant lethals as determined by the failure of the larva to emerge within 24 h after the eggs were deposited. The ATP treatment reduced the dominant lethals in all broods represented by postmeiotic stages of spermatogenesis except those that were mature spermatozoa at the time of irradiation. Spermatogonia as represented by brood 9-10 d also had reduced number of dominant lethals. The decrease in radiation induced dominant lethals was probably due to the extra energy source available to aid in the repair of gross chromosomal aberrations by the exogenous ATP. Pretreatment with ATP and irradiation in air followed by a post-treatment of nitrogen limited the repair ability of the introduced ATP to brood 4-5 d which represented spermatids at the time of irradiation. The exogenous ATP, however, did not influence the radiation induction of sex-linked recessive lethals, translocations, and deletions of the X-chromosomes. (Abstr.)

1209 Mosse, I.B., Turbin, N.B., Freimanis, J. EFFECT OF CONJUGATE AROMATIC SYSTEMS ON HEREDITY. I. MUTAGENIC AND ANTIMUTAGENIC EFFECT OF CERTAIN INDENE COMPOUNDS. Dokl. Acad. Nauk belorussk. SSR 8, 12 (1964) 827-829. (In Russian)

Male Drosophila melanogaster of a wild strain D-18 of high mutability and 0.35% spontaneous mutability were raised on media containing 0.12, 0.8, 4.0, or 25-35 mg/g, respectively, of 3-amino-2-phenyl-1-iminoindene-HCl (I), 3-amino-2-methyl-1-iminoindene-HCl (II), the Na

salt of 2-phenyl-1-carboxymethylaminoindene (III), and the p-carboxy anil of bindone (IV). Subsequently, some of the Drosophilae were irradiated with 1500 R from a ^{60}C source, as were some controls raised on a standard diet. I and III in association with irradiation caused a definite lowering of lethal mutations, compared with the sum of the frequency of such mutations induced separately by the chemicals and the irradiation. II, while by itself inducing a definite increase in the frequency of spontaneously emerging recessive lethal mutations up to 1.2%, brings about a lowering of the genetic effect of γ-irradiation, as does III, but to a smaller degree. IV, which is not toxic, produced the most significant lowering of the genetic effect of γ-irradiation. (CA)

1210 Mosse, I.B., Freimanis, Y.F. EFFECT OF VARIOUS COMPOUNDS ON SPONTANEOUS AND γ-RADIATION-INDUCED MUTABILITY OF Drosophila melanogaster. Vop. Eksp. Genet. (1965) 112-120. (In Russian)

Male Drosophila strain D-18 were grown on a medium containing indene compounds. The effect of these compounds on the frequency of occurrence of spontaneous and radiation-induced changes in chromosome I was studied. Four compounds: 2-phenyl-3-(carboxymethylamino)-1-indone, 3-amino-2-methyl-1-imino-2-indene-HCl, 3-amino-2-phenyl-1-imino-2-indene-HCl, and bindone p-carboxyanil, decreased the frequency of radiation mutations from ^{60}Co in a dose of 1.5 kR. However, the 1st 2 compounds increased the frequency of spontaneous mutations by 2.5-3.5-fold, while the latter 2 had no effect. Two other compounds, dibenzoylenedihydroisonicotinic acid and 2,6-dimethyl-3,5-dicarboethoxy-4-carboxy-1,4-dihydropyridine, were genetically inactive. (CA 66:1967, 82913z)

1211 Mukherjee, R.N. MODIFICATION OF RADIATION-INDUCED MUTATION FREQUENCIES BY ANTIBIOTICS IN Drosophila melanogaster. Diss. Abstr. 27, 4 (1966) 1040-B.

The experiments reported in the present dissertation were undertaken to obtain further evidence for the possible roles of protein, RNA, and DNA macromolecules in radiation-mutagenesis In D. melanogaster. Several antibiotics were tested for their modifying effects on the frequency of radiation-induced sex-linked recessive lethals. Pre-radiation treatment with actinomycin D significantly reduces the frequency of induced mutations in germ cell stages assumed to include spermatids and spermatocytes. These results are consistent with the hypothesis of a role of proteins in the stabilization (repair) of radiation-induced premutational lesions. Puromycin, a specific inhibitor of protein synthesis is ineffective in the modification of induced mutation frequencies in D. melanogaster. Mitomycin C is itself a potent mutagen in all germ cell stages, peak mutagenicity occurring in spermatid stages. In combination with γ-rays, mitomycin C shows an overall additivity of effect. Mutation frequencies due to mitomycin C are not altered by pre- or concurrent treatment with actinomycin D. This may indicate a different mechanism for mutagenesis by mitomycin C and radiation. (Auth.)

1212 Mukherjee, R.N. THE POTENTIATING EFFECT OF SODIUM FLUORIDE ON THE INDUCTION OF MUTATIONS BY x-RAYS IN MATURE SPERMATOZOA OF Drosophila melanogaster. Int. J. Radiat. Biol. 12, 4 (1967) 385. Also presented at "Netherlands Radiobiological Society, Wageningen, 24 Feb. 1967".

Earlier studies by Sobels* have clearly established the operation of a post-irradiation repair phenomenon in fully mature spermatozoa of Drosophila. To analyse the possible role of metabolic processes in the postulated repair from genetic radiation damage, studies have been made on the effects of sodium fluoride, a specific inhibitor of glycolysis, in the modification of radiation-induced mutation frequency in mature sperm. 3-d-old males of D. melanogaster, with a ring X-chromosome of the genetic constitution $X^{C^2}yB/sc^8Y$, were injected with 1×10^{-3} M NaF solution in physiological saline, or with saline alone. After 2 h the injected males were exposed to a dose of 2000 R x-irradiation, given at 46 R/sec (100 kV, 4 mA and 1 mm Al). The treated males were individually mated to single females ($y\ sc^{S1}$ In 49 sc^8) for a 24-h period, and the progeny were tested for induced sex-linked recessive lethal mutations. In seven replicate experiments NaF has been found to enhance consistently the frequency of radiation-induced mutations, as compared with the saline controls. A total of 6134 treated X-chromosomes in the NaF+x-ray series

* see III/722

and 5213 chromosomes in the saline + x-ray series were tested, and the frequencies of mutations were 7.6% and 5.4%, respectively; the difference is highly significant ($P < 0.001$). Injection of NaF alone does not result in changes from the level of spontaneously occurring mutations. Studies on induced dominant-lethal frequencies did not show significant differences between the two groups receiving NaF or saline before irradiation. This presumably indicates that NaF does not affect the initial radio-sensitivity of the treated sperm. This point is being further clarified by a study of translocations induced by such treatments. A possible explanation for the above results is that NaF inhibits the repair of radiation-induced damage and thereby causes a greater yield of mutations in the mature spermatozoa. (Abstr.)

1213 Murakami, A. THE EFFECT OF 5-BROMODEOXYURIDINE (BUDR) ON THE FREQUENCY OF 14 MeV FAST NEUTRON INDUCED MUTATIONS IN THE GONIAL CELLS OF THE SILKWORM. Rep. natn. Inst. Genet., Misima No.17 (1966) 103-104.

1214 Nasrat, G.E. THE EFFECT OF PRETREATMENT WITH MALEIC HYDRAZIDE OF THE MUTATION RATE INDUCED BY GAMMA RADIATION IN Drosophila melanogaster. Idengaku Zasshi (Jap. J. Genet.) 42 (1967) 39-42.

Treatment with γ-radiation in combination with maleic hydrazide exhibits an additive effect on the formation of sex-linked recessive lethal mutations, when applied to D. melanogaster spermatozoa. (Auth.)

1215 Netherlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Rijswik. PRESERVATION OF FOOD BY MEANS OF RADIATION. p.27-31 of "Application of Atomic Energy in Agriculture. Annual Report, 1963". EUR-1882.e. 1964, 46p.

Physiological and biochemical studies of soft fruits irradiated with 0.5 - 1.0 MeV electrons showed that the study of immediate physiological irradiation effects is significant only under precise conditions of environment. Apples, pears, soft fruit, and vegetables were used to determine the effectiveness of 1 - 3 MeV electrons in surface pasteurization. The radiomimetic effects of γ-irradiated glucose were studied in Allium cepa, Hordeum sativum, and Vicia faba, and in mice and Drosophila. (From NSA 18:1964, 4399)

1216 Oak Ridge National Lab., Tenn. AEC-NASA SPACE BIOLOGY PROGRAM. p.98-100 of "Biology Division Semiannual Progress Report for the Period Ending August 15, 1964". ORNL-3700. Oak Ridge National Lab., Tenn, Nov. 1964, 197p.

The preparation of stocks of Habrobracon and Neurospora conidia are reported for use in biosatellite experiments on the effects of known doses of radiation, weightlessness, and absence of diurnal cycle in plants and animals. (NSA 9:1965, 2074)

1217 Oak Ridge National Lab., Tenn. AEC-NASA SPACE BIOLOGY PROGRAM. p.105-110 of "Biology Division Semiannual Progress Report for Period Ending July 31, 1965". ORNL-3853. Nov. 1965, 222p.

The design of a radiation exposure chamber for use in the whole-body exposure of mice to 35- and 57-MeV protons is described. Results are reported from preliminary studies of lens opacification in mice following exposure to 35- and 57-MeV protons. Ground-based experiments were performed in preparation for the biosatellite experiment in 1966 to test the design of packages for Neurospora and Habrobracon, and to provide a preliminary biological assay of the effects of acceleration, impact, and vibrational parameters alone and in combination with low-level γ-radiation. (NSA 20:1966, 6783)

1218 Parkash, O. THYMIDINE TERATOGENESIS AND MUTAGENESIS IN Drosophila melanogaster. Experientia 23, 10 (1967) 859-861. (With German summary)

The investigation was undertaken partly in order to investigate the extent to which mutagenic effects due to labelled thymidine might be due to the thymidine rather than the radiation emitted. Unlabelled thymidine (1-2%) was therefore added to the nutrient medium, and proved to be teratogenic. In experiments using different strains of D. melanogaster, morphological malformations of a very specific type (increase in the number of scutellar bristles; wing margins clipped.

the number, size, and position of the cuts varying; venous anomalies; irregular abdominal bands; abdominal malformations; leg deformations) were observed in all cases. In addition, thymidine at those concentrations also proved mutagenic for sex-linked recessive lethals. The mutagenic effect can be reduced by x-irradiation of the thymidine prior to use. The possible causes of the teratogenic and mutagenic effects of thymidine in D. melanogaster are discussed.

1219 Parkash, O. MUTAGENIC EFFECT OF IRRADIATION DNA IN Drosophila melanogaster. Nature, Lond. 214 (1967) 611-612.

Fish sperm DNA was used. The experimental procedure, method of irradiation of DNA, and the dose were exactly as reported earlier (see III/710), except that the M-5 technique was used for scoring sex-linked recessive lethals. In 1242 chromosomes from 123 males grown on food mixed with unirradiated DNA (2%), only 1 lethal (0.08%) was detected, whereas in 1623 chromosomes from 114 males grown on food containing irradiated DNA (2%), 17 lethals (1.04%) consisting of 4 clusters of 2 and 9 singles were scored. The results are statistically significant (not as high, 5.7%, as reported previously) and indicate that irradiated DNA is mutagenic. Discrepancies in the results of various workers are discussed, together with possible explanations.

1220 Rinehart, R.R. x-RAY INDUCED CHANGES IN Drosophila GERM CELLS. Three-Year Comprehensive Report September 1, 1964 - August 31, 1967. SAN-590-2, San Diego State Coll., Calif. 1967, 62p.

Possible mutagenicity of irradiated Drosophila food and food supplements was investigated. The data support the following conclusions: irradiated Drosophila medium is mutagenic; medium supplemented with DNA or autoclaved sucrose is mutagenic whether irradiated or not; irradiated or nonirradiated nonautoclaved sucrose is not mutagenic; aging the food or food supplements does not significantly alter the mutation frequencies. Earlier reports of decreasing survival with extended anoxic treatments were substantiated when either attached-X or ring-rod heterozygous females were irradiated and posttreated with helium. Detachment frequencies increase with increasing anoxia. Effects of anoxia on the frequency of x-ray induced sex-linked recessive lethality and x-ray induced chromosome loss are described. Data indicate that the Y-chromosome may be able to both suppress and enhance X-chromosome lethality. (NSA 21:1967, 36539)

1221 Rinehart, R.R. INFLUENCE OF HELIUM POSTTREATMENTS AND EXPOSURE FRACTIONATION ON x-RAY INDUCED DOMINANT OR SEX-LINKED RECESSIVE LETHALITY AND X-CHROMOSOME LOSS IN STAGE 7 OOCYTES OF Drosophila melanogaster. Genetics 56, 3 Pt.2 (1967) 583-584. Also presented at "1967 Meetings of the Genetics Society of America, Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

Newly eclosed (0-6 h) Drosophila females were exposed to 3000 R delivered in He and posttreatments of 15 min, 1 h, or 6 h of anoxia were given. In other experiments in an air atmosphere, 3000R-exposures were given acutely or in equal increments separated by 1 h. Only the 1st 24 eggs laid by each female were included in the experiments to limit the test of Stage 7 oocytes. A ratio of the number of surviving offspring to the total number of eggs laid gave the percent survival values reported. X-chromosome loss was measured among the F_1 progeny and appropriate females from this group of flies were mated for another generation to obtain sex-linked recessive lethal frequencies. - There was an increase in dominant lethality associated with prolonged anoxic treatments. There was a decrease, however, in sex-linked recessive lethality in the gametes that survived the x-ray and helium treatments to the F_1. Exposure fractionations in air resulted in a decrease in both dominant and recessive lethality. Radiation induced X-chromosome loss was relatively refractory to the extended He or exposure fractionation treatments. A hypothesis is proposed in which it is suggested that a large part of both dominant and recessive lethality in Stage 7 oocytes may be due to a common lesion and that with prolonged anoxia some potential recessive lethal events may be changed to dominant lethals. (Abstr.)

1222 Rinehart, R.R., Ratty, F.J. MUTATION IN Drosophila melanogaster CULTURED ON IRRADIATED WHOLE FOOD OR FOOD COMPONENTS. Int. J. Radiat. Biol. 12, 4 (1967) 347-354.

The frequencies of sex-linked recessive lethal mutations were measured in germ cells from Drosophila males cultured on aged or non-aged, irradiated or non-irradiated whole food or food supplements. In the first series of experiments, herring sperm DNA of low mol. wt was given

150 kR of unfiltered x-rays from a constant-potential machine at ~5000 R/min. In the 2nd series a 30% non-autoclaved sucrose solution was irradiated with 3000 kR of γ-radiation from a linear accelerator at an exposure rate of 10^6 R/min. The experiments indicate that irradiated whole food, autoclaved sucrose, and heterologous DNA are mutagenic. Non-autoclaved sucrose whether irradiated or not, does not induce mutations. A large portion of the increased damage may be associated with the induction of gonial mutants. Aging the treated food or food components for three weeks before use does not alter the results.

1223 Saksonov, P.P., Antipov, V.V., Shashkov, V.S., Razgovorov, B.L., Murin, G.F. et al. ON THE BIOLOGICAL EFFECTS OF HIGH ENERGY PROTONS. p.1-5 of "Translations of Biophysics and Physiology". 1965, 27p. Translated from: Dokl. Akad. Nauk SSSR 162, 3 (1965) 688-693. N65-31039, Joint Publications Research Service, Washington, D.C.

The RBE of protons in comparison with γ-rays was analysed using various tests characterizing the vital activity and heredity of the cell or organism. The experiments showed that for protons with energies of 660 and 120 MeV, the RBE with respect to DL 50 for mice and rats was about 0.7. Clinical observations of animals also showed the somewhat lesser effectiveness of protons in comparison with γ-rays. The same results were obtained upon conducting a comparative analysis of chromosomal disturbances in the cells of the bone marrow of mice, in the growth of seeds in higher plants, and in determining recessive sex-associated and dominant lethal mutations in Drosophila melanogaster. Tests on mice were conducted to study the radiation protective effect of various compounds.

1224 Sankaranarayanan, K. THE EFFECTS OF NITROGEN AND OXYGEN TREATMENTS ON THE FREQUENCIES OF x-RAY-INDUCED DOMINANT LETHALS AND ON THE PHYSIOLOGY OF THE SPERM IN Drosophila melanogaster. Mutation Res. 4, 5 (1967) 641-661.

The induction of dominant lethals in D. melanogaster males with a ring-X chromosome was studied following irradiation with 4000 R under anoxia with N_2 and O_2 post-treatments. The post-radiation treatment with these gases varied from 25 min - 120 min. The frequencies of induced dominant lethals were found to be in the range of 67% - 73% in the different experiments with no significant differences resulting from the contrasting post-treatments. These frequencies increased linearly in the successive egg-collecting periods, the trend being independent of the different post-treatments. Following prolonged N_2 treatments, a sharp increase in the proportion of unhatched eggs was noticed. Examination of the ventral receptacles and spermathecae of females inseminated by N_2-treated males revealed that with N_2-treatment(1) there occurred a drastic reduction in the number of spermatozoa stored, the magnitude of reduction being dependent on the length of N_2-treatment and (2) there was a decrease with time in the number of spermatozoa remaining in the storage organs, with the effect being pronounced with 96 and 120 h of storage following insemination. These findings are discussed in relation to physiological damage to the treated sperm and sperm exhaustion. (Auth.)

1225 Seecof, R., Kaplan, W.D. THE FAILURE OF IRRADIATED DNA TO PRODUCE MUTATION IN Drosophila melanogaster. Drosoph. Inf. Serv. 41 (1966) 101.

Om Parkash reported, Nature 205:1965, 312 (see III/710), that irradiated DNA was mutagenic when fed to D. melanogaster. We repeated this experiment, following his reported procedure as closely as possible. We subjected herring sperm DNA (Calbiochem) to 100 000 R of x-rays at 644 R/min at 100 keV, 7 ma, with filtration equivalent to 0.6 mm of Al. The irradiated DNA was added to a final concentration of 18 mg/ml into a food medium containing sucrose (5%), agar (1%), corn meal (6%), bran (1.5%), and propionic acid to pH 4.5. In series 1, 1-to 3-d-old Oregon-R flies (5 pairs) were introduced to treated food in a half-pint bottle and allowed to lay eggs for 12 d at 20°C. Series 2 was the same except that 20 pairs were used and were changed to fresh treated food every 2 d. Adult Oregon-R males, offspring of flies fed upon treated food were mated, each to five M-5 females, for detection of sex-linked lethals. Series 1 repeats the technique used by Parkash. Series 2 was designed to distinguish between mutations induced in the X-chromosome of the adult females feeding upon treated food for 12 d, and effects upon larval germ cells. Table 1 summarizes the data and shows that the rate of mutation was not elevated above the control rate which is at about 0.2% for our stock. A high sterility characterized the F_1 matings. This, however, is attributable to the males of the Muller-5 stock in use at

that time, rather than to an effect induced by the irradiated DNA upon the Ore-R chromosomes. (Auth.)

1226 Sharma, R.P. RADIOSENSITIZATION OF Drosophila melanogaster BY N-ETHYLMALEMIDE. Drosoph. Inf. Serv. 41 (1966) 112.

2.5 ml of 100 μM solution (pH7) of N-Ethylmalemide was mixed with 2.5 ml of basic medium, comprised of agar (3%), yeast (10%), glucose (10%), propionic acid (0.4%) and water (100 ml), to get 50 μM concentration of the chemical. Freshly laid Drosophila eggs (Oregon-K) were transferred to this medium and allowed to develop up to adult stage. The newly emerged males were collected and kept for 2 d. One batch was kept as such, whereas the other batch was irradiated with 2400 R of x-rays. The males collected from the normal medium were irradiated with the same radiation dose to serve as control for the chemical-radiation combination treatment. The males were crossed with M-5 virgin females at the rate of one male and three females. The sex-linked recessive lethals were scored in F_1. The combination treatment of chemical and radiation showed about 2-fold increase (5.4%) in the frequency of sex-linked recessive lethals over radiation (2.8%). The chemical alone is not able to produce any mutation. The possible explanation for such radiosensitizing effect produced by N-Ethylmalemide may be due to its ability to combine and inhibit the sulphydryl groups. (From abstr.)

1227 Shiomi, T. DIFFERENTIAL EFFECT OF PENICILLIN ON x-RAY INDUCED MUTATIONS IN Drosophila melanogaster. p.64-65 of "Annual Report 1964". NIRS-4, National Inst. of Radiological Sciences, Chiba (Japan). Dec. 1965. 94p.

The experiments were designed to test the effect of pre-feeding with penicillin on radiation effects at the mature sperm stage, using three successive 1-d-broods. Feeding with penicillin prior to exposure to 2000 R x-rays appears to reduce the induction of point mutations as recessive lethals but has no effect on chromosomal aberrations. In the case of mature sperm within the female penicillin produced no effect on the induction of either the recessive lethals or translocations, but was effective in the reduction of dominant lethals. The somewhat complicated results may be due to differences in physiological condition or metabolic processes within the mature sperm stage.

1228 Shiomi, T. EFFECT OF PENICILLIN FEEDING ON THE FREQUENCY OF x-RAY INDUCED MUTATION IN Drosophila. Genetics 54. 5 (1966) 1077-84.

Feeding of penicillin to larvae prolonged the larval growth period about 1 d. However, the rate of emergence was higher than in the control. Penicillin exhibited no mutagenic action at the concentrations used (20 000 units/ml culture medium). Sex-linked recessive lethal mutation in sperm x-rayed during the last 3 d of development was decreased about 50% when larvae were fed with penicillin, compared to the control raised on normal food. The relation between radiation dose and mutation remained linear in the penicillin-fed series, as in the control. Penicillin was more effective in reducing mutation when fed during the 1st half of larval stage than during the 2nd half. (Auth. summary)

1229 Shiomi, T. SENSITIVITY DIFFERENCES IN THE SUCCESSIVE STAGES OF SPERMATOGENESIS IN Drosophila AFTER IRRADIATION IN NITROGEN OR AIR. Mutation Res. 4 (1967) 323-332.

The influence of N_2-treatment on the pattern of radiosensitivity in the successive stages of spermatogenesis in Drosophila was studied. x-irradiation was administered either in air or in an atmosphere of N_2, and the frequencies of induced sex-linked lethals and II-III translocations in five successive 1-d broods (with 10 females per male per brood) were compared. Four levels of radiation exposure, namely 1000 R, 2000 R, 3000 R and 4000 R were used to irradiate the males. In the air controls, the observed frequencies of lethals and translocations in broods A to E, when plotted graphically, produce asymmetric "U"-shaped curves, with an initial high frequency in brood A, low frequencies in broods B and C, and then a sharp increase through brood D to a very high frequency in brood E. The differences between the frequencies in broods A and B are more pronounced at higher than at lower doses. After radiation exposure in N_2, (1) a reduction in the mutation and translocation frequencies is observed, the effect in the latter being more pronounced, and (2) the frequencies obtained in broods A, B and C being nearly equal. This indicates that the differential yield of mutations between mature and almost mature spermatozoa originates from

differences in oxygenation. N_2-treatment affects the fertility and fecundity of the treated males with the mean number of progeny produced by each fertile male being reduced by about 22 and 78% with 30- and 60-min exposure to N_2, respectively. Some of the causal factors that might underlie the N_2-effect are discussed. (Auth.)

1230 Sinkha, S.P. EFFECT OF ETHYLENE-DIAMINETETRAACETIC ACID SODIUM SALT ON THE PROCESS OF CROSSINGOVER IN DIFFERENT LINES OF Drosophila melanogaster. Vest. leningr. gos. Univ., Ser. Biol. 20, 2 (1965) 130-135. (In Russian, with English summary)

The modifying effects of EDTA on the amount of crossing over in the b cn vg region of the IInd-chromosome has been studied among heterozygous females of four wild strains, Maharaj, D-32, D-18 and R-86 of Drosophila melanogaster. In early studies it was shown that two of the strains, Maharaj and D-32, have comparatively lower spontaneous crossover frequency and are more radio-resistant to x-rays than the strains D-18 and R-86 which are radiosensitive to x-rays and have higher spontaneous crossover frequency. In the present study it has been found that EDTA increases the crossover frequency in two radio-resistant lines Maharaj and R-86, whereas no statistically significant increase is marked in the two radio-sensitive strains D-18 and R-86. The increase reported in the strains Maharaj and D-32 is mainly due to increase in the euchromatic cn-vg region The heterochromatic region b-cn, which encloses the centromere, does not show any increase. EDTA decreases the fertility of heterozygous females in all 4 strains, but more in the strains R-86 and D-18 than in Maharaj and D-32. Chelating the metallic ions like Ca and Mg, necessary for the chromosomal integrity, EDTA breaks the linear continuity of the chromatids leading to cross-over. It has been proposed that the strains Maharaj and D-32, where increase in crossover frequency is found, contain comparatively more amount of Ca^{++} and Mg^{++} ions in its chromosomes, than the strains R-86 and D-18. This is why in the first 2 strains EDTA could remove Ca^{++} and Mg^{++} inducing crossingover, whereas in the last 2 strains R-86 and D-18 this removal of ions appeared to be lethal for the cell and hence caused a great decrease in the fertility. The increase of crossover frequency in the euchromatic cn-vg region may be due to the reason that in this region the degree of spiralization of chromatids is comparatively poor, and thus EDTA gets more scope for its chelating action. In the light of these data, it has been possible to propose that these 4 different strains may be differing with each other in the degree of spiralization of their chromatids. (Auth.)

1231 Sisakyan, N.M., Antipov, V.V., Saksonov, P.P., Yazdovskiĭ, V.I. INVESTIGATION OF BIOLOGICAL EFFECT OF COSMIC RADIATION UNDER CONDITIONS OF SPACE FLIGHTS. "14th Congr. intern. Astronaut. Paris, France, 1963". Polish Scientific Publishers, Warszawa, Poland, 1965.

Présentation des résultats de l'étude radiobiologique effectuée sur sept vaisseaux spatiaux soviétiques (vaisseaux 2, 4 et 5 et Vostoks 1, 2, 3 et 4). Emploi, aux fins de l'étude, de l'effet traumatisant des rayonnements, d'objets présentant diverses radiosensibilités. Description des expériences effectuées sur des mammifères (chiens, souris, rats, etc.), des insectes, des plantes d'espèce supérieure, etc. (Bull. signalétique)

1232 Sisakyan, N.M., Antipov, V.V., Saksonov, P.P., Yazdovskiĭ, V.I. STUDY OF THE BIOLOGICAL ACTION OF COSMIC RADIATION UNDER CONDITIONS OF COSMIC FLIGHTS. Radiobiologiya 4 (1964) 337-343. (In Russian)

The effect of ionizing radiation on the hereditary structures of cells was studied in various organisms: Drosophila melanogaster, seeds of higher plants, lysogenic bacteria (Escherichia coli), microspores of Tradescantia paludosa, and others. The studies were carried out on the Sputnik and Vostok flights. At the altitudes of 180 - 320 km, for 1.5 - 96 h, total radiation doses were 1.5 - 60 mrad, respectively. 90% of the radiation was from cosmic radiation and 10% from the earth's radiation field because of the 65° inclination of the orbit. Slight but statistically significant damage was observed in the hereditary structures of the cells. However, comparison with data obtained in the laboratory indicates that these results are due to the complex effects of vibration, acceleration, and weightlessness as well as to radiation. The type of data obtained were the frequency of dominant and sex-linked recessive lethal mutants in Drosophila, for example. The results are compared with those on human and animal tissues, seaweed, and bacteria carried in Discoverer XVII flights. These organisms received 30 to 35 rad but only the bacteria showed any damage. (NSA 18:1964, 33351)

1233 Smittle, B.J. EFFECT OF AERATION ON GAMMA IRRADIATION OF HOUSE FLY PUPAE. J. econ. Ent. 60, 6 (1967) 1594-1596.

When 3-d-old pupae of the housefly, Musca domestica L., were exposed to O_2, CO_2, and air during γ-irradiation, aeration had no effect on eclosion, but eclosion was reduced as much as 10% by exposure to 6000 R. The percentage sterility produced by the γ-rays in males and females was reduced by CO_2. The other treatments had no apparent effect. (Auth.)

1234 Sobels, F.H. THE CONTRASTING EFFECTS OF O_2 AND N_2 IN DETERMINING INITIAL SENSITIVITY AND POST-RADIATION RECOVERY IN Drosophila SPERM AND SPERMATIDS. Int. J. Radiat. Biol. 7, 5 (1964) 505. Also presented at "Meeting of the Netherlands Radiobiological Society, Rijswijk, (ZH), The Netherlands, 1964".

1235 Sobels, F.H. PROCESSES UNDERLYING REPAIR AND RADIOSENSITIVITY IN SPERMATOZOA AND SPERMATIDS OF Drosophila. p.49-64 of "Genetical Aspects of Radiosensitivity: Mechanisms of Repair, Proceedings, Vienna, 18-22 April 1966". STI/PUB/130. International Atomic Energy Agency, Vienna (Austria). 1966, 175p.

When Drosophila males are exposed to x-irradiation under anoxia, and the effects of post-treatment with N_2 are compared with those with O_2, a reduction of the mutation- and translocation-frequencies is observed with N_2 in spermatozoa, but with O_2 in early spermatids. Since the same results have now been obtained with spermatozoa treated in inseminated females, and with spermatids from 24-h-old pupae, these post-radiation modifications cannot be from errors in the sampling of germ cells with different radiosensitivities. Experimental evidence suggests that in both types of cells, the post-radiation effects arise from enzymatic repair of potential lesions leading to mutation or chromosome breaks. For sperm it could be demonstrated that neither post-radiation interaction of radicals with O_2, nor selective elimination of cells with genetic damage by post-treatment with N_2 can explain the observed effects. Radiosensitization after pre-treatment with sodium fluoride, iodoacetamide, ribonuclease or actinomycin-D suggests that in sperm both glycolytic enzymes and RNA or protein synthesis are involved in the repair process. In the early spermatids, on the other hand, oxygen is clearly required for repair to occur, and inhibition of RNA and/or protein synthesis by pre-treatment with actinomycin-D, ribonuclease or chloramphenicol leads to a reduction of the radiation-induced mutation frequency. Studies on the origin of stage-specific differences in radiosensitivity showed that early spermatids are characterized by a considerably higher O_2enhancement ratio than spermatozoa. Their greater response to radiation as compared with sperm thus arises from a greater intrinsic sensitivity to the induction of radiation damage in the presence of O_2. O_2enhancement ratios for fully mature spermatozoa and late spermatids, however, do not differ significantly, but the higher radiosensitivity in the former than in the latter cells appears to originate from a greater degree of oxygenation, under normal conditions in air. (Auth.)

1236 Sobels, F.H., Michael, B., Mukherjee, R.N., Sankaranarayanan, K., Watson, W.A.F. REPAIR OF RADIOSENSITIVITY PHENOMENA IN Drosophila MALES. p.12 of "3rd International Congress of Radiation Research, Cortina d'Ampezzo, 26 Jun.-2 Jul, 1966, 263p." Abstr. 48. Also published in p.502-521 of "Radiation Research 1966", Amsterdam, The Netherlands, North-Holland Publishing Company, 1967.

When Drosophila males are exposed to x-irradiation in N_2, and the effects of post-treatment with N_2 are compared to those of O_2, a reduction of the mutation and translocation frequencies in sperm is observed with N_2 post-treatment, but in early spermatids with O_2 post-treatment. Evidence has now been obtained that these post-radiation modifications cannot be due to errors in the sampling of cells with different radiosensitivity. In spermatids oxygen-dependent repair is not observed after the application of a low dose rate. This "inverted" dose rate effect (will be) discussed. Current experiments are directed towards an elucidation of the possible mechanisms underlying post-radiation recovery by N_2 in mature sperm. Post-radiation interaction of radicals with O_2 seems unlikely. Radiosensitization by sodium fluoride suggests repair by glycolytic enzymes. Possible selective effects of chromosome breakage events will be discussed on the basis of dominant lethal and chromosome loss data. Studies on differences in radiosensitivity showed that early spermatids have greater intrinsic sensitivity to radiation damage in the presence of O_2 than mature sperm, but the higher sensitivity of mature sperm as compared to very late spermatids appears to originate from a greater degree of oxygenation in the former. (Abstr.)

1237 Sobels, F.H. RBE VALUES FOR GENETIC EFFECTS OF 15 MeV NEUTRONS IN RELATION TO STAGE SENSITIVITY IN Drosophila. Int. J. Radiat. Biol. 13, 4 (1967) 378-379. Also presented at "Netherlands Radiobiological Society Meeting. Rijswijk (ZH), The Netherlands, 17 Nov. 1967".

The mutagenic effectiveness of 15 MeV neutrons was compared with that of x-irradiation in mature spermatozoa, sampled from the first ejaculate of 7-d-old males, and late spermatids, sampled from that of 2-3-h-old males. After x-irradiation in air, more mutations are produced in spermatozoa than in spermatids, but after exposure in either O_2 or N_2, roughly equal mutation frequencies are obtained in the two stages. Mature sperm thus appears to be better oxygenated than the late spermatids. In consequence, a greater relative biological effectiveness of neutron irradiation was expected in the relatively anoxic late spermatids. After irradiation with doses of 3000 rad of either x-rays or 15 MeV neutrons, the following frequencies of recessive lethals in a ring X-chromosome, and of II-III translocations were observed: (1) For lethals in sperm, 6.7% (67/1001) with neutrons and 9.7% (242/2488) with x-rays, and in spermatids, 7.8% (154/1985) with neutrons and 6.3% (162/2586) with x-rays, corresponding to RBE values of 0.69 and 1.24 for sperm and spermatids respectively. (2) For translocations in sperm, 7.6% (55/723) with neutrons and 7.3% (148/2028) with x-rays, and in spermatids, 6.8% (112/1685) for neutrons and 3.2% (72/2251) for x-rays. The ratio of effectiveness for neutrons versus x-rays can be calculated 1.05 in sperm and 2.14 in spermatids. The results show that in the cells which are by nature relatively anoxic, neutrons are more effective in producing genetic damage than x-rays. Since tumour cells are also relatively anoxic, i.e. compared with the surrounding normal tissues, the possible advantages of fast neutrons over x-rays for radiotherapeutic purposes seem well documented. The unusually low RBE value of 0.69 for lethals in mature sperm is ascribed to the use of 15 MeV neutrons, pure sperm samples, and a ring X-chromosome. Lethals associated with translocations are eliminated from the ring, and it is this class of damage that is characterized by relatively high RBE values. (Abstr.)

1238 Tazima, Y., Onimaru, K. MODIFICATION OF γ-RAY-INDUCED MUTATION FREQUENCIES IN THE SILKWORM BY POST-TREATMENT OF SPERMATIDS AND SPERMATOZOA WITH NITROGEN. Rep. natn. Inst. Genet., Misima No.17 (1966) 92-94.

1239 Thobbi, V.V., Srihari, T. GROWTH RESPONSE OF Prodenia litura Fabr. IN RELATION TO THE CASTOR LEAVES OBTAINED FROM IRRADIATED PLANTS. Ind. J. Ent. 29, 2 (1967) 154-156.

The food values of two types of castor leaves, Ricinus communis Linn., are compared, obtained from different sources of irradiation. The dwarf and the short along with the standard strain of $H.C_6$ were used, the dwarf mutant resulting from treatment with 10 000 R γ-rays and the short mutant from treatment with 2.5×10^{12} n/cm² of fast neutrons. The development of P. litura larvae was subsequently studied after feeding on these three types of castor leaves. Leaves obtained from $H.C_6$ proved more nutritive than those from dwarf and short mutants, the larvae reared on $H.C_6$ weighing significantly more on the 11th day of hatching than those fed on the other two sorts of leaves. The growth index value and the percentage of pupation were highest for $H.C_6$.

1240 Thomas, J.J., Jr., Baxter, R.C., Fenn, W.O. INTERACTIONS OF OXYGEN AT HIGH PRESSURE AND RADIATION IN Drosophila. p.36-37 in "Brief Description of Research Published or Accepted for Publication During 1966". Annual Report. Neumann, W.F., Rothstein, A., Eds, UR-49-784, Rochester Univ., N.Y. Atomic Energy Project. 1 Apr. 1967, 253p.

For abstract, see 1282.

1241 Thornley, M.J. METABOLIC CONDITIONS BEFORE AND AFTER IRRADIATION. p.170-192 of "Radiation Effects in Physics, Chemistry and Biology". Amsterdam, North-Holland Publishing Co. 1963.

Nine papers presented at the Second International Congress of Radiation Research are summarized. The papers deal with the importance of metabolic processes in both initial radiation damage and the process of repair. Specifically, studies on a variety of topics are reported, including the effects of various modifying agents on radiation-induced lethals in Drosophila males.

1242 Watson, W.A.F. POST-RADIATION RECOVERY IN EARLY SPERMATIDS AND SPERMATOCYTES SAMPLED FROM Drosophila PUPAE. p.234 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy, 26 Jun.-2 Jul. 1966, 263p". Abstr.930.

Earlier work by Sobels showed that post-treatment with O_2 as compared to post-treatment with N_2, favours repair of genetic damage induced by irradiation under anoxia in spermatids and spermatocytes sampled from adult flies. Attempts to show that this repair occurred when pupae were irradiated were unsuccessful when the same experimental procedure was followed. However, when 24 h-pupae are pre-treated with N_2 for 6 h, irradiated in N_2 with 2500 R x-rays, and post-treated with either O_2 or N_2 for 2 h, then in the 1st 1-d-brood there is a consistent decrease in mutation frequency (as measured by recessive lethals in a ring-X chromosome) after post-treatment with O_2, as compared to that with N_2. For five experiments, involving 6000 tested chromosome sets altogether, the average lethal frequency for N_2 was 6.5%, and that for O_2 4.7%. Statistical analysis using 2 × 2 contingency tables gives a probability of 0.004 (two-sided test). This result shows that the similar results obtained from earlier broods of adult flies did not originate from artefacts in the sampling technique, and support Sobels' conclusion that there is a repair system operating at this stage of development. Further data concerning the effect of higher doses and the induction of dominant lethals and translocations (will be) presented at the meeting. (Abstr.)

1243 Watson, W.A.F., Sankaranarayanan, K. POST-RADIATION RECOVERY IN SPERMATIDS SAMPLED FROM 24 HR OLD PUPAE OF Drosophila melanogaster. Genetica 38 (1967) 62-63.

Male pupae with a ring-X chromosome of the genetic constitution $X^{Cl}y$ B/sc^8Y were subjected to 6 h pretreatment with N_2, irradiated under anoxia with a high dose-rate of 46 R/sec at three different exposure levels (1250 R, 2500 R and 3750 R) and then posttreated for 2 h with either N_2 or O_2. Following eclosion, the males were mated individually with six females for a 24-h-period and the progeny were utilised for sex-linked lethal and translocation tests. The results indicated a consistent and highly significant decrease in mutation and translocation frequencies following O_2 post-treatment and that the absolute reduction of the lethal frequencies was approx. the same at the three exposure levels. This was conceivably due to the fact that the repair system could cope with only a limited amount of damage and became saturated at high doses so that the repair was most effective when the dose was low. The results confirmed and provided additional evidence for the postulated oxygen-dependent repair system operating in spermatids. The effects of four dose rates (16.6 R/sec, 8.3 R/sec, 4.2 R/sec and 2.1 R/sec) at two exposure levels (2500 R and 1250 R) were investigated. The results indicated that the frequencies of sex-linked lethals at both the levels of radiation exposure were far from being significantly different between the N_2 and O_2 post-treated groups. A comparison of these results with those of high dose-rate studies revealed that after irradiation at low dose rates, the mutation frequencies following both N_2 and O_2 post-treatments were strikingly similar to those obtained at high dose-rate exposures with N_2 post-treatment indicating that at lower dose rates, O_2 post-treatment was no longer effective in bringing about repair. A possible explanation of these observations was that the repair process in spermatids proceeded in such a short time that after prolonged exposures to irradiation no repair was possible.
(NSA 22: 1968, 521)

1244 Watson, W.A.F. POST-RADIATION RECOVERY IN EARLY SPERMATIDS SAMPLED FROM Drosophila PUPAE. Mutation Res. 4, 2 (1967) 169-176.

When 24-and 48-h-old Drosophila pupae were subjected to 6 h pre-treatment with N_2, irradiated under anoxia, then post-treated for a further 2 h with either O_2 or N_2, it was found that in the first one-day brood from the 24-h pupae there was a consistent and highly significant decrease in the mutation frequency following O_2 post-treatment, as compared to that with N_2. This result confirms earlier findings of Sobels, and demonstrates the existence of an O_2-dependent repair process operating in early spermatids of Drosophila. It was observed that more repair occurred at low than at high doses (i.e. the relative reduction in mutation frequency was greater), and the suggestion is put forward that the repair system can handle effectively only a limited amount of damage, but becomes saturated when this amount is exceeded at higher doses. The fact that translocation frequencies are also lowered by oxygen post-treatment is taken as an indication that potential breaks, rather than chromosome breaks, are involved in the repair process. Dominant lethal studies showed that it is most unlikely that the repair process could be due to an artefact caused by O_2 selectively eliminating cells carrying mutations. (Auth. summary)

1245 Wolff, S. MECHANISMS OF DOSE-RATE EFFECTS: INSIGHTS OBTAINED FROM INTENSITY AND FRACTIONATION. Idengaku Zasshi (Jap. J. Genet.) 40 Suppl. (1965) 38-48.

Contrary to early results in radiation genetics, results are now being obtained that indicate intracellular repair of one-hit genetic lesions. In some of these cases, however, other explanations have not been unequivocally ruled out. For instance, one must make sure that stage sensitivity coupled with mitotic delays and reversions and even cells selection do not obscure the results. There is more clarity in regard to two-hit intergenic mutations. These have long been known to undergo restitutional repair. By the use of dose fractionation techniques, it has been possible to separate effects on repair from effects on breakage and, by inhibiting various metabolic processes between two doses of radiation, some insight has been gained into the chemical processes involved in repair. Much of the experimental data has been obtained from studies on Drosophila.

1246 Yoon, J.S. GENETIC x-RADIATION DAMAGE AND ITS MODIFICATION BY SOME GASES AND A TIME FACTOR IN Drosophila melanogaster. Diss. Abstr. 27, 1 (1966) 337-B.

Oregon-R, Oak Ridge Strain males, 19 to 21 h old, were x-rayed with a total dose of 1000 R or 3000 R given in two equal fractions of 500 R or 1500 R at a dose rate of 500 R/min, except experiment # 1 in which they were given a single dose of 1000 R at 24 ± 1°C in several gas environments, with a time interval of 20 min or 40 min between the two doses. At each change of gases, the system was evacuated to remove all gases, then flushed with He for 1 min. Tests using CO were carried out in the dark and the others in the light, both at 1 atm of the gas or gas mixture. In order to study the genetic radiation damage and its modification in the presence of several gases and a time factor, the frequencies of dominant lethals and translocations induced in cells which were in different stages of spermatogenesis were scored using 7 sequential 2-d matings over a 2-week test period. The frequency of dominant lethals increased from sperm to spermatids and meiotic cells, then increased in spermatogonia. The spermatogonial cells were the least susceptible to x-rays. The cycle of damage for dominant lethals is similar to that for translocations, but does not coincide with it completely, and the peaks of damage for both are located in early post-meiotic stages. The cycle of frequencies of translocations coincides with that of percentages of sterility of F_1. The coincidence of frequencies between translocations and the sterility demonstrates that the mechanisms of damage for both are related, at least in part. The NO (nitric oxide) effect on sperm and late spermatids is more drastic than the O_2 effect, but a major fraction of the effect is to cause the death of the sperm, or to slow down spermatogenesis. A duration of 4 min of gases in post-treatments appears to be too short to modify the damage. CO during radiation increases genetic damage above the other gases tested. No evidence of reduction in damage due to gas changes between radiation doses was demonstrated. There are few or no translocations recovered from pre-meiotic cells. The Y-chromosome was involved in 10.8% of total breaks, or about 1/4 as frequently as the two autosomes tested, and chromosomes II and III equally participated in an interchange. (From DA)

1247 Zakladnoi, G.A. RADIOSENSITIVITY OF THE GRANARY WEEVIL AS A FUNCTION OF TEMPERATURE. Vest. sel'khoz. Nauki, Mosk. No.3 (1967) 138-141. (In Russian, with French summary)

Varying the temperature between 10 and 30°C before and during irradiation (11 000 rad γ-radiation from a ^{60}Co-source) had very little effect on mortality of the granary weevil, Sitophilus granarius L. A relationship was found to exist between post-irradiation temperature and mortality rate. An increase in temperature after irradiation drastically narrowed the mortality range.

1248 Zhukov-Verezhnikov, N.N., Volkov, M.N., Yazdovskiĭ, V.I., Mayskiĭ, I.N., Saksonov, P.P. et al. MODERN GENETICS AND PROBLEMS IN SPACE BIOLOGY. p.161-164 of "Aviation and Space Medicine". Parin, V.V., Ed. 1964, 464p. Translation of: "Aviatsionnaya Kosmicheskaya Meditsina". Moscow, Akad. Med. Nauk SSSR. 1963. N65-13683, National Aeronautics and Space Administration, Washington, D.C.

An overall view of future research to develop genetic safeguards for space travel is presented, on the basis of new information derived from a genetic analysis of the offspring of Drosophila and lysogenic bacteria that were carried on various Vostok space flights. The experiments with lysogenic bacteria imply that a combination of vibrations and γ-rays followed by vibrations almost doubled the genetic effects of the γ-rays. However, since effective levels of cosmic radiation

were lacking in the orbits, it is assumed that weightlessness may be a possible source of genetic effects. The selection of lysogenic bacteria is advocated for future research to develop substances to prevent genetic changes, to determine the effects of weightlessness, and to study blocking of the pathological information present in the DNA of these bacteria.(Scient. A. Techn. Aerospace Repts.)

See also:

27 Application of radioactive isotopes to the investigation of methods for the biological control of pests. V. The effects of γ-radiation on pupae of C. capitata previously labelled with ^{32}P. (Arroyo, M. et al., 1965)

944 Cytogenetic analysis of lethal mutations induced at various stages of spermatogenesis. (Hashim-Ahmed, M.S., 1965)

949 The relative mutagenic effectiveness of fast neutrons and x-rays in pre- and post-meiotic germ cells of Drosophila melanogaster. (Lamb, M.J. et al., 1967)

950 Molecular and radiation genetics. Annual Report 1965. (Leiden Rijksuniversiteit (Netherlands), 1966)

951 Can Drosophila spermatozoa be used in studies of recovery processes? (Lüning, K.G., 1961)

957 Annual report of the National Institute of Genetics, No.16, 1965. (National Inst. of Genetics, Mishima (Japan), 1966)

965 Dose-rate effect in the repair of radiation damage in spermatids of Drosophila melanogaster. (Sankaranarayanan, K., 1967)

970 Oxygen dependent differences in radiosensitivity between fully mature and almost mature spermatozoa. (Sobels, F.H., 1966)

976 Comparative study of the radiosensitivity at different stages of oogenesis. (Tikhomirova, M.M., 1967)

1001 The effects of x-rays on the chromosomes of locust embryos. II. Chromatid interchanges and the organization of the interphase nucleus. (Fox, D.P., 1966)

1002 The effects of x-rays on the chromosomes of locust embryos. III. The chromatid aberration types. (Fox, D.P., 1967)

1003 The effects of x-rays on the chromosomes of locust embryos. IV. Dose-response and variation in sensitivity of the cell cycle for the induction of chromatid aberrations. (Fox, D.P., 1967)

1016 Early chromosomal response to x-rays. (Leach, W.M. et al., 1966)

1017 Lack of x-ray induced chromosome "stickiness" in grasshopper neuroblasts. (Leach, W.M., 1967)

1025 Evidence for the two-hit nature of x-ray induced crossing-over in the centromeric region of Drosophila males. (Olivieri, G. et al., 1964)

1026 Interaction of x-ray and fast neutron-induced chromosome breaks in Drosophila. (Reddi, O.S., 1966)

1027 Identification of the proposal: x-ray induced changes in Drosophila germ cells. Progress Report, Sep.1, 1965 - Aug. 31, 1966. (Rinehart, R.R., 1966)

1038 Genetical after-effects of x-rays depending on the temperature regime. (Tikhomirova, M.M. et al., 1967)

1074 Comparison of frequency patterns between whole-body and fractional mutations induced by x-rays in Drosophila melanogaster. (Inagaki, E. et al., 1966)

1080 Mutagenic effect of 600-MeV proton irradiation. (Lamb, M.J. et al., 1966)

1081 The mutagenic effect of 600-MeV protons in Drosophila melanogaster. (Lamb, M.J. et al., 1967)

1087 Recent research on mutations induced by irradiation. (Meyer-Döring, H., 1960)

1089 Dose rate and time factor. (Mole, R.H., 1963)

1092 Mutagenic effects of massive acute x-irradiation in Drosophila melanogaster. (Nakao, Y. et al., 1965)

1095 Biological studies: genetics. (National Inst. of Radiological Sciences, Chiba (Japan), 1965)

1099 x-Ray induced changes in Drosophila germ cells. Three-year Comprehensive Report, Sept. 1, 1964 - Aug. 31, 1967. (Rinehart, R.R., 1967)

1126 Occurrence of dominant lethals in Drosophila under the influence of vibration, acceleration and γ-irradiation. (Darfenov, G.P., 1965)

1174 Effects of x-rays, tryptophan metabolites, and eye color mutants on the tumor-suppressor system in Drosophila melanogaster. (Brooks, G.T., 1967)

1250 Disproportionate amounts of genetic damage induced by ethylenimine and x-radiation treatments. (Alexander, M.L., 1966)

1263 The action of radiation and other mutagenic agents, 1. in inducing mutation in Drosophila females, and 2. in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, H.B., 1966)

1271 Relative biological effectiveness of 14 MeV neutrons to gamma-rays for inducing mutations in mature sperm of the silkworm. (Murakami, A., 1966)

1272 Relative biological effectiveness of x-ray and gamma radiation. (Seeley, B.A. et al., 1966)

1277 Relative biological effectiveness, comparison of hard x-ray, soft x-ray, and beta radiation. (Stone, K.J., 1967)

1410 Modification of fitness in species and strains of flour beetles due to x-ray and DDT. (Erdman, H.E., 1966)

1418 The effect of x-rays and visible light upon the one day old meal worm, Tenebrio molitor, embryo. (Po-Chedley, D.S., 1966)

1425 Lifespan studies with strains of gamma-irradiated Drosophila adults. (Sonnenblick, B.P. et al., 1967)

1439 Radiation studies with the boll weevil: lethal effects on larvae, pupae, and adults; male sterility and dose fractionation. (Flint, H.M. et al., 1966)

1508 Genetics. (National Inst. of Radiological Sciences, Chiba (Japan), 1966)

1592 Control of fruit flies by gamma rays. (Huque, H. et al., 1966)

2.1.10. Comparative Studies (Radiations. Mutagenic Chemicals. Physical Factors)

1249 Akov, S. RETENTION OF THE BLOOD-MEAL IN Aedes aegypti FOLLOWING STERILIZATION S BY CHEMICALS AND IRRADIATION. Ann. trop. Med. Parasit. 60 (1966) 482-494.

Egg development in A. aegypti is inhibited by γ-irradiation and by chemosterilants. Whether chemosterilization and irradiation cause other physiological alterations, in addition to the more conspicuous effects on fertility, was examined. The effects of metepa (tris(2-methyl-1-aziridinyl) phosphine oxide), apholate (2,2,4,4,6,6-hexa(1-aziridinyl)2,4,6-triphospha-1,3,5-triazine), and tepa (tris(1-aziridinyl) phosphine oxide) on blood-digestion in A. aegypti females is described and compared with that of γ-irradiation. Elimination of the blood-meal was retarded in females previously treated with metepa, apholate, or tepa. A delay in blood-digestion was also observed in irradiated females, the retention of the blood-meal being most obvious 48 h after feeding. The midgut proteolytic enzyme activity in females treated with chemosterilants or irradiation was not lower than in the controls. The delay in blood-digestion was not due, therefore, to a lack of midgut proteases. Retention of the blood-meal was not due to an acute toxic effect, since it occurred also when the first blood-meal was given 8 d after treatment. No delay in the elimination of the blood-meal was observed following the second blood-meal. (NSA 22: 1968, 2546)

1250 Alexander, M.L. DISPROPORTIONATE AMOUNTS OF GENETIC DAMAGE INDUCED BY ETHYLENIMINE AND x-RADIATION TREATMENTS. p. 19 of "3rd International Congress of Radiation Research, Cortina d'Ampezzo, Italy, 26 Jun.-Jul. 1966, 263p". Abstr. 74.

Recessive lethal mutations were compared in the sex chromosome and second autosome of Drosophila melanogaster after ethylenimine treatment, x-ray treatment and combined treatments of both. When x-rays (1500 R) were given 1 d after treatment with 0.0004 ml of a 10^{-2}M solution of ethylenimine, the rate of sex-linked recessive lethals was equal to the sum of both types of treatment. However, with the combined treatment the rates for autosomal recessive lethals were not increased above that observed with x-ray treatment alone. When the time between the chemical treatment and x-rays was extended to 3 d, the combined treatments produced an additive or possibly synergistic effect for both sex-linked and autosomal recessive lethals. For sex-linked lethals, the ethylenimine, x-ray and combined treatments gave values of 4.0%, 2.5% and 6.4% when x-ray was given 1 d after chemical treatment. When x-ray treatment was given 3 d after the

chemical, the values were 5.2%, 4.2% and 11.3% for ethylenimine, x-ray and the combined treatments. For autosomal lethals, a rate of 20.0% was observed for the combined treatments when x-rays were given 1 d after the chemical. The rates were 14.4% and 24.9% for the x-ray and ethylenimine tests. With x-ray treatment 3 d after the chemical, 34.2% lethals were observed as compared to 12.8% for the chemical and 11.7% for x-rays. Ethylenimine as a mutagenic agent for autosomal lethals is not effective or is destroyed when x-rays are given 1 d after chemical treatment. If the chemical is allowed to act 3 d before x-ray treatment, an additive or possibly synergistic effect is observed for recessive lethals in both the X and autosomes. (Abstr.)

1251 Alexander, M.L. GENETIC DAMAGE INDUCED IN THE SEX CHROMOSOME AND AUTOSOMES, WITH x-RAY AND ETHYLENIMINE TREATMENTS. Radiat. Res. 31, 3 (1967) 614. Abstr. Eb-6, presented at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Spermatogenic germ cells of Drosophila melanogaster were treated with 1500 R of x-ray, injected with .0004 ml of a 10^{-2} M solution of ethylenimine or treated with ethylenimine followed by x-radiation 1 or 3 d later. Sensitivity of sperm and spermatids are similar with the chemical treatment; spermatids do not show increased sensitivity as with x-ray and their sensitivity is not affected by combined treatments. Premeiotic germ cells show low sensitivity to both mutagenic agents. Genetic damage - recessive lethals induced in treated cells - observed in the X-chromosome with combined treatments approximately equals the sum for x-ray and ethylenimine. Mosaic lethals, induced the generation following chemical treatment, are not affected by x-ray treatment in the X-chromosome. The results with autosomes differ from the X-chromosome in several ways. The rate of mosaic lethals is lower in relation to complete lethals with chemical treatment. The rate of recessive lethals induced in the second chromosome by x-ray is not increased by ethylenimine if x-ray treatment is given 1 d after chemical treatment. In some cases, a rate equal to the sum of the x-ray and ethylenimine rate is observed if x-ray is not given until 3 d after chemical treatment. The induction of recessive and mosaic lethals in the X-chromosome with x-ray and ethylenimine appears to be completely unrelated. The autosomal results indicate that there is some interference or competition of the two agents in some phases of induction of recessive lethals. (Abstr.)

1252 Ascher, K.R.S. A REVIEW OF CHEMOSTERILANTS AND OVIPOSITION-INHIBITORS IN INSECTS. Wld Rev. Pest Control 3, 1 (1964) 7-27.

Work on chemosterilants and oviposition-inhibitors is reviewed. The advantages of chemosterilants over conventional killing methods are discussed, as are possibilities of combining them with insecticides. Chemical and radiation-induced sterilization are compared (p.12-13). The effects of chemosterilants on metabolism and behaviour, species specificity and problems connected with the application of chemosterilants are reviewed.

1253 Aubele, A.M. A COMPARISON BY MEANS OF x-IRRADIATION IN AIR AND IN OXYGEN OF THE SUPPRESSOR-ERUPT SYSTEMS IN SEVERAL STRAINS OF Drosophila melanogaster. Diss. Abstr. 27, 11 (1967) 4166-B.

A specific suppressor system, the suppressor-erupt -- erupt, was analysed in several strains of D. melanogaster. There is no significant difference between the frequencies of total erupt produced after x-irradiation in the suppressor-erupt strain used in this investigation and those found originally in earlier studies on this strain. A decrease in the expressivity of the suppressor-erupt system in the suppressor-erupt strain may be indicated by the lower frequency of extreme erupt out of the total erupt class which was obtained in the present study of this strain. Differences in penetrance and expressivity, particularly after x-irradiation in 100% O_2, obtained in the Su-er tu bw; er^+ su-tu^+ strain and in the al b Su-er^+ c tu^+ sp^2; er^+ su-tu^+ strain after replacement of their respective second chromosomes by the second chromosome of the suppressor-erupt strain indicate some change between the original suppressor-erupt second chromosome and that now present in the Su-er^+ tu bw; er^+ su-tu^+ strain. Additional modifiers on the X-chromosome of the Su-er tu bw; er^+ su-tu^+ strain which act to enhance suppression of the erupt response are also suggested by results obtained with several substitution strains. Action of x-rays by direct enhancement of the effect of the erupt alleles is not supported from the results obtained in this investigation, since the penetrance and expressivity of the er^+ allele after x-irradiation differed among substitution strains having the same er^+ allele

together with different suppressor of erupt alleles in the second chromosome. The major action of x-rays in producing the erupt phenotype appears to be an interference with the action of the suppressor of erupt associated with any given er or er^+ allele. The presence of O_2 during irradiation exerts a differentiating effect on the expression of erupt in the various strains tested. Combinations of second and third chromosomes with the same levels of extreme and total erupt after x-irradiation in air were found to differ from each other after x-irradiation in 100% O_2. (From DA)

1254 Baumiller, R.C. EFFECT OF SIGMA VIRUS ON DEVELOPMENTAL DELAY IN Drosophila melanogaster, CAUSED BY x-RAY INDUCED MUTANTS IN HETEROZYGOUS CONDITION. Mutation Res. 4, 6 (1967) 831-836.

Four strains of D. melanogaster were tested for their response to newly introduced heterozygous mutants both when infected with sigma virus and when cured. Each experiment involved the following procedure: Virgin females were obtained from an infected strain and its sibling or closely related uninfected substrain. Uninfected males aged for 3 d were or were not treated with 3000 R of x-rays. Radiated and control males were then mated to the two kinds of females providing four types of individuals for each strain: (1) uninfected control; (2) uninfected radiated; (3) infected control and (4) infected radiated. Two unstably virus infected strains show a significantly enhanced deleterious effect of such mutants when virus is present. Two stably virus infected strains show a significantly enhanced effect when virus is absent. These reactions are apparently not correlated with the mode of infection, stable or unstable, of a given viral strain. It is hypothesized that genetic differences between the flies, their virus, or both are responsible for the differences observed: stably infected flies being less stressed by heterozygous mutants when infected than when cured, unstably infected flies being more stressed by heterozygous mutants when infected than when cured.

1255 Botstein, C., Schulz, R.J. EXPERIENCE WITH HIGH ENERGY ELECTRON BEAM THERAPY. Progr. Radiat. Therapy 3 (1965) 27-48.

Some radiobiologic aspects of fast electron therapy are considered, particularly by comparison with properties and effects of other radiations, and some experimental and clinical studies with high-energy electrons are reported. A table shows the variation of RBE values (0.69 to 1.0) with 18- to 35-MeV electrons for various animal species. There are indications, based on both physical considerations and clinical observations, that electron beams are biologically more effective near the end of their path of penetration. The results of 4 studies designed to detect differences between RBE at surface and depth in unit density phantoms are examined. Three of the 4 experiments failed to show a change in RBE; however, the striking increase found in Drosophila studies indicates the need for further experimentation. Clinical experience suggests that the observable tissue reactions differ both qualitatively and quantitatively from those produced by conventional x-rays. Various aspects of dosimetry, and particularly the problem of output standardization of high-energy electron accelerators in terms of dose delivered at the dose max. in a phantom composed of tissue equivalent material, are discussed. Specific advantages of fast electron therapy are examined.

1256 Browning, L.S., Altenburg, E. A COMPARISON OF THE STERILIZING EFFECT OF x-RAYS, QUINACRINE MUSTARD AND AZASERINE ON Drosophila MALES. Drosoph. Inf. Serv. 40 (1965) 83.

Males of Muller's Maxy stock were treated with x-rays, quinacrine mustard and azaserine and individually mated (in vials) to Maxy females (2-3 per male). The males were transferred to new food vials with fresh virgins every third day for several such broodings. The dose of x-rays was 3000 R or 5000 R and that of the quinacrine sufficient to give a 2-3% lethal rate in mature sperm. The azaserine was weakly mutagenic (about 1% lethal inducing). In the present experiments, the x-rays produced a drastic drop in fertility in the third brood (8-10 d after treatment) from which there was a large measure of recovery in the fourth brood. In the case of chemical treatments, there was no such definite brood pattern. The effect of the three agents on the fertility of the Maxy males is tabulated. The results might indicate that the reduced fertility of the males after the chemical treatments is due to a toxic effect on their soma (reducing their life span and fitness to mate), rather than a sterilization of the germ cells at a sensitive stage (as in the case of x-rays), since the viability of the cultures undergoes considerable reduction from one brood to the next after the chemical treatments. With the x-rays, there is no such drastic drop in their viability. (From auth.)

1257 Campion, D.G. THE STERILISATION OF LEPIDOPTEROUS PESTS BY RADIATION AND CHEMOSTERILANTS. PANS 13, 4 (1967) 392-405.

1258 Carillo, J.L., Ortega, A., Rodriguez, J. EFECTO ESTERILIZANTE DE LAS RADIOCIONES GAMMA COMPUESTO "APHOLATE" SOBRE LA CONCHUELA DEL FRIJOL. (Sterilizing effect of γ-rays and apholate on the Mexican bean beetle, Epilachna varivestis Muls.) Agricultura téc. Méx. 11, 4 (1963/1964) 168-175. (In Spanish)

The doses required for sterilization were low compared with other species. A ^{60}Co-source was used, and the effects of irradiation tested on eclosion and on reproduction. Doses up to 12 000 R were used. - The insects used were laboratory-bred. The effects of γ-rays were studied on the emergence and reproduction of adults irradiated at the egg stage. Doses of 150, 300, 600, and 1000 R were used, and the number of emerged adults noted (Table 1). At 150 R, egg development was unimpaired, the percentage of developed eggs was 27% (30% for unirradiated controls). At 1000 R, no eggs developed. Table 2 gives the number of eggs produced by pairing insects emerged from irradiated eggs. At 150 R, oviposition was not impaired; at 300 R, copulation and oviposition occurred but the eggs did not develop. Pupae were irradiated (1) to estimate the effect of various doses given to pupae of the same age on development and reproduction of adults, and (2) to estimate the effect of one single irradiation dose given to pupae of various ages on development and reproduction of adults. - The average lethal dose was also determined, using x-rays. Tabulated data (Table 3) show radiation effects on adult eclosion from pupae irradiated at different ages; the viability of eggs produced by pairing of irradiated and unirradiated insects (Table 4); and the effects of irradiation of pupae of various ages with 1500 R on adult emergence (Table 5). - Similar experiments were carried out using chemosterilants.

1259 Chandley, A.C. A COMPARISON BETWEEN THE EFFECTS OF x-RAYS AND HEAT TREATMENT ON RECOMBINATION IN THE X-CHROMOSOME OF Drosophila melanogaster. p. 51 of "3rd International Congress of Radiation Research, Cortina d'Ampezzo, Italy. 26 Jun.-2 Jul.1966", 263p. Abstr.199.

Previous workers have shown that x-rays produce a marked inhibition of crossing-over at the distal end of the X-chromosome of D. melanogaster and an induction of crossing-over in the centromere region. It has also been known for many years that heat-treatment of females can produce an increase in crossing-over in the centromere region of the autosomes. We have now made a comparative study of the effects produced in the distal and centromere regions of the X-chromosome by the two agents. A similar comparison was made by Mavor and Svenson (1924) for Chromosome II but their study was confined to the proximal segments only. Females of the genotype y^2 sc car. sc^{V_1} ac^+ y^+/y^2 cv v f were used so that recombination could be measured along the full length of the chromosome, including the region spanning the centromere from car-y^+. Virgins were divided into three groups: irradiated with 3000 R x-rays, kept unmated for 24 h at 34°C, and controls. Apart from the period at 34°C, all flies were cultured at 25°C. The females were then mated singly in vials and transferred daily to fresh vials for 15 d. Recombination was scored for each region on each day. For the proximal region the results resemble those of Mavor and Svenson (1924) for Chromosome II. In the segment car-y^+ heat produced a two-fold increase in crossing-over on days 6, 7 and 8. On day 9, the level returned to the control value. x-rays produced an increase on every day up to day 15, but the biggest increase came on days 5, 6, 7 and 8 when it equalled the increase found with heat treatment. In the middle of the chromosome (v-f, f-car), neither agent had any effect. In the distal segments (sc-cv, cv-v) heat and x-rays both gave greatly reduced crossing-over on days 6-9, but the heat-treated females again showed a return to the control level by day 10. x-rayed females showed only partial recovery, the decreased level of crossing-over persisting up to day 15. Thus, the effects of heat treatment over days 6-9 exactly parallel both the proximal increase and the distal decrease produced by x-rays, but whereas the x-ray effect persists indefinitely, the heat effect is confined to this 4-d period. In addition, x-rays induce crossing-over in late oocytes which have already finished natural meiotic crossing-over (days 1-5). (Abstr.)

1260 Fahmy, O.G., Fahmy, M.J. BIOLOGICAL ORGANIZATION IN RELATION TO DIFFERENTIAL GENE RESPONSE TO MUTAGENS. p. 14-25 of "Induction of Mutations and the Mutation Process". Veleminsky, J., Gichner, T., Eds. Prague, Publishing House of the Czechoslovak Academy of Sciences, 1965.

Theories on chromosome structure and mutagenesis are reviewed. Results are reported from studies in Drosophila on the effects of x-radiation or the chemical mutagens, triethylenemelamine or a mustard derivative of phenylalanine, that demonstrated the relevance of each unit of biological structure to the process of mutagenesis, starting from the cell level through the chromosome and the gene to the subgenic elements that approach macromolecular dimensions. The degree of differential mutagenicity induced by x-radiation and the chemicals was assessed by determining the absolute mutation rate at 11 specific loci. The relative response of each locus to the different mutagens was compared and a complementation map was prepared of the rudimentary locus and the distribution of cistons damaged by the various mutagens. Studies on the mutagenic specificity of DNA showed that both homologous and heterologous DNA are effective in the induction of small chromosome deletions resulting in the autosomal dominants known as minutes, and to a lesser extent in the induction of point mutation visibles. It was also shown that a great many polymers of natural and synthetic origin possess the DNA type of mutagenicity. The specificity of action of DNA was studied on the 4th chromosome by comparing the distribution of minutes with that induced by x-radiation and recovered under the same conditions. The implications of the specific action of one mutagen on one locus and the possible genetic effects of synthetic macromolecules specific to particular loci are discussed. (NSA 20: 1966, 40706)

1261 Fahmy, O.G., Fahmy, M.J. THE NATURE AND DISTRIBUTION OF THE MUTATIONS INDUCED BY UNIRRADIATED AND IRRADIATED HETEROLOGOUS DEOXYRIBONUCLEIC ACID IN Drosophila melanogaster. Genetics 54, 5 (1966) 1123-38.

The only mutations appreciably induced by calf-thymus DNA (injected into adult males or fed to larvae) were small chromosome deletions: Minutes, and elimination of Bar from a marked Y-chromosome. Very weak activity also occurred as regards point mutations (recessive lethals and visibles) which was equivalent for the X- and 2nd-chromosome: these gave mutation frequencies in the proportion of their physical lengths (1: 2). The yield of point mutations was not increased by *irradiation (> 400 000 R) of DNA prior to its larval feeding. DNA was inactive as regards the induction of (a) X-chromosome breaks, leading to viable fragments of X0 males, and (b) non-disjunction, whether among the sex chromosomes, or the 4th autosomal pair. The proportion of 4th chromosome Minutes after the injection of calf-thymus DNA reached 26% of the total induced, which was considerably lower than that occurring with the other tested samples of the heterologous and homologous material (ranging from 85-45%). This variation seemed to be a function of the physicochemical state of the polymer, rather than its chemical constitution or biological source. The 2nd chromosome recessive lethals, recovered after the feeding of calf-thymus DNA, were mainly small deletions which were localized in segments rich in heterochromatin, especially around the centromere. Intercrosses between the independently induced mutations, however, did not yield any instances of allelism, indicating that the mutagenic selectivity of DNA did not extend to the genic level. (Auth. summary)

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1262 Friedman, L.D., Kiriazis, W.C. CHEMICALLY INDUCED VIABILITY MUTANTS IN D. melanogaster. Drosoph. Inf. Serv. 41 (1966) 87.

Studies are in progress on the relative frequency of chemically induced sex-linked lethals and detrimental mutations and their effect on the viability of D. melanogaster. Tests were made on 3925 X-chromosomes from Basc and Canton-S strains that were treated with the monofunctional alkylating agent ICR 100. The treated males were injected with 0.1% ICR 100 in 0.4% saline. Parents were discarded after 3 d so that the effects measured were on mature sperm. The experimental design and analysis is the same as used previously for similar studies with x-rays* Estimates were made on the proportions of complete lethals and the genetic load of lethals and detrimentals induced. (1) The complete sex-linked lethal frequency induced by this compound in our experiments has been on the average of about 4.5%. There is no significant difference between the lethal rates induced in the + and Basc chromosomes. This differs from the results obtained with x-rays. (2) The ratio of the genetic load from non-lethal detrimental mutants to that from lethals was .390. The load is computed as the product of the frequency and the average effect on viability. It is a

* (See III/594).

much higher value than any effect of the same kind that has been established for x-ray. This indicates a much higher detrimental effect in relation to lethals that has been induced by the chemical mutagen in comparison to the effect caused by x-ray. Further studies are in progress including the determination of the induced mosaic lethal frequency. (Auth.)

1263 Glass, H.B. THE ACTION OF RADIATION AND OTHER MUTAGENIC AGENTS 1. IN INDUCING MUTATION IN Drosophila FEMALES, AND 2. IN CONTROLLING THE ACTION OF SPECIFIC GENES RESPONSIBLE FOR SUPPRESSING UNCONTROLLED GROWTH. NYO-1472-1, Johns Hopkins Univ., Baltimore, Md. 28 Feb. 1966, 35p.

The results of studies since 1953 on the comparative mutagenic effects of ionizing radiations on males and females are described, at comparable stages of the germ line. It is stressed that, when discussing mutation rates, it is essential to specify not only the sex and the stage of the germ cells at time of treatment (brood: or age of eggs, larvae, or pupae), but also the genetic strain. Translocations are very rarely induced in mature female gametes, inversions are somewhat more abundant after an identical dose of x-rays, and recessive lethals are about 2/3 as frequent in the female gametes as in the spermatozoa. The slopes of dosage curves for sex-linked recessive lethals in Oregon-R males and females diverge significantly (2.8×10^{-5}/R for the male, 1.6×10^{-5}/R for the female). Sex-linked recessive lethals were induced in N, air, and O at 1000, 2000, 3000, and 4000 R; the frequencies of mutations in spermatozoa was uniformly 1/3 higher than obtained in mature oocytes. Good agreement was obtained in an autosome, chromosome 2, giving a mutation frequency in spermatozoa a little over 1.5 times the frequency in oocytes. Dominant Minute-bristle mutation studies are described, including studying the effect of a 5-R dose of x-rays. Work is also reported on the critical period for the effect of x-rays on the suppressor genes, and the occurrence of suppressor genes su-er and su-tu in wild-type strains. The effect of mating patterns on life span is also investigated.

1264 Hochmann, B. EMS AND ICR-100 INDUCED CHROMOSOME 4 LETHALS IN D. melanogaster. Drosoph. Inf. Serv. 42 (1967) 59.

Two chemical mutagens, ethyl methanesulfonate (EMS) and quinacrine mustard (ICR-100), when injected separately into Oregon-R males in the laboratory, have each induced 4th chromosome recessive lethal mutations at a frequency approximating 4%. This mutational response of the microchromosome is about four times that produced by x-ray doses of 3 or 4 R (see III/599). Details of the various experiments and their results are discussed.

1265 Jenkins, J.B. MUTAGENESIS AT A COMPLEX LOCUS IN Drosophila WITH THE MONOFUNCTIONAL ALKYLATING AGENT, ETHYL METHANESULFONATE. Genetics 57, 4 (1967) 783-793.

Ethyl methanesulfonate (I) is a potent mutagenic agent in Drosophila, inducing mutations at the dumpy locus with a frequency of $\geq 2\%$. Mutations were found in the progeny of males, both after feeding and after injection with I, and the induced mutation frequency was proportional to the concentration injected. I acted primarily on postmeiotic sperm cells, the premeiotic and meiotic cells remaining relatively immune to its effects. 98% of all the induced mutants detected in the F_1 were mosaic (containing mutant and non-mutant tissue). 35% of all the F_1 mutants contained mutant tissue in their gonads. The average amount of mutant tissue in a mosaic gonad was 56%, similar to values reported in studies with ICR-170 and nitrosomethylurea and in other studies with I. However, these values, all ~50%, may be misleading because the variances are so large. With only 23% of transmitted mutations there was a disagreement in the classification of the phenotype found in F_2 compared to F_1. In virtually every such instance of disagreement, the phenotype was less severe in F_1 than in F_2. A comparison is made of the transmitting dumpy mutants induced with I, nitrosomethylurea, x-rays, and ICR-170, and a model of the dumpy region is constructed based on this comparison. (CA 68: 1968, 27781w)

1266 Khan, A.H. MUTAGENIC ACTIVITY OF IRRADIATED FOOD CONSTITUENTS. Nucleus, Lahore 3, 1/2 (1966) 30-31.

Experiments designed to detect a mutagenic effect of DNA towards Drosophila larvae after the DNA was exposed to a heavy dose of ionizing radiation prior to its addition to a chemically-defined and axenic Drosophila medium are described. Although non-irradiated DNA is found to be mutagenic

under these conditions, the prior irradiation of the DNA does not change the mutagenic effectiveness of the DNA compared with the non-irradiated DNA sample. (Auth.)

1267 Kitaoka, S. et al. EFFECTS OF GAMMA RADIATION AND CHEMOSTERILANTS ON THE CATTLE TICK, Boophilus microplus. Jap. J. sant. Zool. 18, 2?3 (1967) 126-129.

Thiotepa proved the most potent sterilant followed by apholate and metepa, and finally hempa. Irradiation doses of 10 to >1000 kR inhibited oviposition.

1268 Klassen, W., Norland, J.F. STERILIZATION OF BOLL WEEVILS WITH COMBINATIONS OF CHEMOSTERILANTS AND RADIATION. Bull. ent. Soc. Am. 13, 3 (1967) 203. Abstr. 358, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Dominant lethal mutations in post-meiotic germ cells are readily induced by apholate, busulfan, N, N, N', N'-tetramethyl-P-piperidino-phosphonic diamide and cyclic diester of 1 aziridinyl-phosphonic acid with pentaerythritol. Spermatogonical cells are destroyed by 3 kR of 200 kVp x-rays. Combinations of chemosterilant and x-rays induce permanent sterility. (Abstr.)

1269 Landa, Z., Ed. MECHANISM OF MUTATION AND INDUCING FACTORS. "Proceedings of a Symposium, Prague, Czechoslovakia, 9-11 Aug. 1965". Prague, Publishing House of the Czechoslovak Academy of Sciences. 1966, 524p. CONF-650814.

The induction of mutations in plants, Drosophila, mice, and rats by exposure to γ-, neutron, u.v., and x-radiations is discussed in 40 papers. Results are included from mutation studies on barley, maize, peas, sugar beets, tobacco, tomatoes, and wheat, Drosophila, mice, and rats. The relative efficiency of ethyleneimine, dimethylsulfate, ethylmethanesulfonate, and hydroxylamine in inducing visible mutations in plants is compared and the induction of mutations in Drosophila by several chemical mutagens is reported. (From NSA 21: 1967, 8776)

1270 Mosse, I.B., Freimanis, Y.F. COMPARATIVE MUTAGENIC ACTIVITY OF SOME AROMATIC COMPOUNDS WITH OR WITHOUT γ IRRADIATION. Genetika No.4 (1965) 69-73.

The effects of nine aromatic compounds were tested in Drosophila for spontaneous and radioinduced mutations. Four preparations V-93, AV-69, F-4 and F-23 proved to be able to reduce the rate of recessive lethal mutations coupled with the sex induced by γ-exposure to 1500 R. Two of them AV-69 and F-23 also proved to be mutagens: AV-69 at the same concentration, F-23 at a greater concentration. The inefficiency of the F-25 and F-6 preparations may be ascribed to their insolubility in the nutrient media. Thus, a new class of genetically active compounds has been established. (Auth.)

1271 Murakami, A. RELATIVE BIOLOGICAL EFFECTIVENESS OF 14 MeV NEUTRONS TO GAMMA-RAYS FOR INDUCING MUTATIONS IN MATURE SPERM OF THE SILKWORM. Idengaku Zasshi (Jap. J. Genet.) 41 (1966) 17-26.

Mature sperm of the silkworm were exposed to fast neutrons or ^{137}Cs γ-radiation at late pupal stage. A series of ^{137}Cs γ-ray irradiation experiments were run in parallel with those 14 MeV neutrons. For the determination of mutation frequency visible recessive egg colour mutations were used as markers. Dose-frequency curves for recovered mutations increased linearly with the increasing dose for both radiations, which indicates that they are due to single-hit events. The frequency curves for mosaics, increased non-linearly, indicating that they are of multi-hit nature. Neutrons of 14 MeV energy were approx. six times as efficient as γ-rays in producing recessive visible mutations in mature sperm of the silkworm. Hence, RBE values of 14 MeV neutrons are larger in mature sperm than in spermatogonia. For the production of mosaics RBE of 14 MeV neutrons relative to ^{137}Cs γ-rays was about 5. (Auth.)

1272 Seeley, B.A., Peterson, J.B., Smoler, M.H. RELATIVE BIOLOGICAL EFFECTIVENESS OF x-RAY AND GAMMA RADIATION. Drosoph. Inf. Serv. 41 (1966) 178.

The RBE of 140 kVp x-rays and γ-rays from a ^{137}Cs-source was compared, by observing the frequency of induced sex-linked recessive lethals. Four series of tests were made with P_1 Canton S males using (1) 3200 R x-rays at 234 R/min, (2) an intense dose of 3200 R γ-rays at 466 R/min, (3) a dilute dose of 3200 R γ-rays at 6.9 R/min, and (4) controls. Results showed a very significant

difference in mutation induction between x-rays and both series of γ-rays, but no significant difference between the two γ-ray treated series. Earlier results (cf. I/818) of ~1.6 for the RBE of a ^{60}Co-source and x-rays were confirmed.

1273 Slizynska, H. CYTOLOGICAL ANALYSIS OF FORMALDEHYDE INDUCED CHROMOSOMAL CHANGES IN Drosophila melanogaster. Proc. R. Soc. Edinb. 66B (1957) 288-304.

Structural changes induced in male auxocytes after formaldehyde feeding were analysed cytologically. In comparison with the effects of x-rays (on mature sperm) there is: (1) a high proportion of mosaics; (2) an excess of repeats and deficiencies; (3) a shortage of translocations, and (4) fewer breaks in the heterochromatic regions. The very high frequency of mosaics and the low ratio of inter- to intrachromosomal changes may be explained by the delayed opening of potential breaks which tend to open simultaneously in the same chromosome but at different times in different chromosomes. The high number of "isochromatid" breaks (repeats) points to some connection with the reduplication cycle. The shortage of "eu-heterochromatic" changes in which "heterochromatic" breaks in salivary gland analysis are scored, can be similarly explained by a difference in the time of opening of potential breaks in the two types of chromatin. Initial non-random distribution of breaks as well as the conditions of rejoining in premeiotic cells may also play some role. (Auth.)

1274 Smith, R.H. DOMINANT AND RECESSIVE LETHAL MUTATIONS INDUCED BY MITOMYCIN C IN Habrobracon OOCYTES AND SPERM. Genetics 56, 3 Pt. 2 (1967) 591. Presented at "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

Mitomycin C is a bifunctional alkylating agent that is a natural antibiotic derived from a species of Streptomyces. Metaphase I oocytes of Habrobracon are approx. 20 times as sensitive to mitomycin C as prophase I oocytes when dominant lethality is the criterion. This is comparable to the action on these two stages of x-radiation and other alkylating agents. When recessive lethality is the criterion, metaphase I and prophase I are essentially the same sensitivity, resembling ethyl methanesulfonate but not x-radiation or nitrogen mustard, where metaphase I has been shown to be more sensitive. Higher doses of mitomycin C than those used on females are required to obtain an effect on the gametes of males. Injected males were mated on three successive days. The dominant lethal frequency increases progressively from brood to brood, but the recessive lethal frequency remains essentially unchanged. Temperature sensitive recessive lethal mutations are induced by mitomycin in sperm. (Abstr.)

1275 Deleted.

1276 Sobels, F.H. STUDIES ON THE MUTAGENIC ACTION OF FORMALDEHYDE IN Drosophila. II. THE PRODUCTION OF MUTATIONS IN FEMALES AND THE INDUCTION OF CROSSING-OVER. Z. indukt. Abstamm.- u. VererbLehre 87 (1956) 743-752.

Although not experimentally, comparisons are made between the effectiveness of x-rays and formaldehyde in inducing crossing-over, which is found to be about equal. Various people's x-ray data are considered (Whittinghill, Auerbach) in the discussion of the relative genetic effects. Drosophila females were exposed to cyanide gas prior to injection with different concentrations of formaldehyde. Compared to females which only received formaldehyde, the frequency of sex-linked lethals was increased by the cyanide pretreatment. Cyanide also enhances the mutagenic effects of formaldehyde on sperm stored in inseminated females.

1277 Stone, K.I. RELATIVE BIOLOGICAL EFFECTIVENESS, COMPARISON OF HARD x-RAY, SOFT x-RAY, AND BETA RADIATION. Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 108. Presented at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

The relative biological effectiveness of hard x-ray (90 kVp), soft x-ray (20 kVp) and β-radiation (^{90}Sr) was compared using lesser cornstalk borer eggs, Elasmopalpus lignosellus. (Abstr.)

1278 Stromnaes, Ø. STOCK DIFFERENCES IN x-RAY MUTATIONAL SENSITIVITY PATTERN OF Drosophila melanogaster. Hereditas 40 2, 3 (1959) 221-229.

Stock dependency of radiation sensitivity was tested on Iso-Amherst and Oslo stocks. Males were irradiated and repeatedly paired with virgin females. The Oslo stock showed greater fertility. Sex-linked lethals were also induced at a lower rate in the Oslo stock.

1279 Sugai, E. EFFECT OF TEMPERATURE ON RADIATION INDUCED MALE STERILITY IN THE SILKWORM Bombyx mori L. Appeared as 1) NSJ-Tr-89, Japan Atomic Energy Research Inst. Tokyo, Dec. 1967, 9p, and 2) Translation of Jap. J. appl. Ent. Zool. 9, 4 (1965) 266-270.

For abstract, see III/726.

1280 Suzuki, D.T., Piternik, L.K., Hayashi, S., Tarasoff, M., Baillie, D., Erasmus, U. TEMPERATURE-SENSITIVE MUTATIONS IN Drosophila melanogaster. I. RELATIVE FREQUENCIES AMONG γ-RAY AND CHEMICALLY INDUCED SEX-LINKED RECESSIVE LETHALS AND SEMILETHALS. Proc. natn. Acad. Sci. U.S.A. 57, 4 (1967) 907-912.

Males were placed in gelatin capsules, irradiated with 4000 R of γ-rays delivered from a 6000 Ci ^{60}Co therapeutic source, at 200 R/min, and mated as outlined in the paper. Sex-linked recessive mutations that are lethals and semilethals at 29°C but survive at 17°C were recovered. Of the lethals and semilethals induced by γ-rays and mitomycin C, 3.2 and 3.5%, respectively, are temperature-sensitive (ts), whereas it is estimated that at least 10.7% of the lethals and semilethals induced by ethyl methanesulfonate are stable ts mutants. Such mutants provide a useful tool for a variety of genetic analyses.

1281 Taylor, K.B., Berryman, A.A., Blackwell, J.L. PROGRESS IN THE STERILIZATION OF THE EUROPEAN PINE SHOOT MOTH. Bull. ent. Soc. Am. 12 (1966) 286. Abstr. 98. Presented at "Portland Meeting, Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

Techniques for mating the European pine shoot moth were developed. Preliminary studies indicated that tepa was an effective sterilant. The potential use of this chemosterilant is compared with γ-irradiation. (Abstr.)

1282 Thomas, J.J., Jr., Baxter, R.C., Fenn, W.O. INTERACTIONS OF OXYGEN AT HIGH PRESSURE AND RADIATION IN Drosophila. J. gen. Physiol. 49 (1966) 537-549.

Oxygen at high pressure (OHP) and x-irradiation can interact in D. melanogaster to potentiate toxic actions characteristic of one agent alone. 1000 kVp x-irradiation in doses of 30, 60, and 75 kR accelerated the acute immobilization of young male Drosophila by O_2 at 7.8 atm, up to rates twice that observed with such O_2-pressure alone. x-Irradiation alone, in these dosages, did not acutely immobilize Drosophila. x-Irradiation during exposure to 7.8 atm pO_2 was more effective and consistent in producing this potentiation than was x-irradiation that preceded exposure to OHP. Acute OHP toxicity in young female Drosophila was not potentiated by 75 kR. On the other hand, shortening of the life span of young males by the above doses of x-irradiation was augmented significantly by a concurrent 40 min exposure to OHP (which alone did not significantly decrease life span). This shows, for the first time, that O_2 can affect not only the acute effects of radiation, but also the residual irreversible effects indicated by life span shortening. (Auth.)

1283 Tokin, B.P. INSTITUT NATIONAL DE GENETIQUE DU JAPON. Genetika No. 3 (1967) 190-195. (In Russian, with French summary)

The research programme at the National Institute of Genetics, Japan, is described. Work on the silkworm, Drosophila and other insects is discussed. The effects of irradiation by means of x- and γ-rays, and by neutrons were studied in terms of resultant cytogenetic modifications and mutations. Work is also described with radioisotopes (^{32}P and ^{131}I).

1284 Trams, A., Kuenkel, H.A., Henke, H. INVESTIGATIONS ON THE MUTAGENIC EFFECT OF NITROSO COMPOUNDS. p. 156-162 of "Biophysikalische Probleme der Strahlenwirkung". Muth, H., Ed. Stuttgart, Georg Thieme Verlag. 1966. (In German)

The mutagenic effect of N-nitroso-N-methyl-urethane, N-nitroso-morpholine, N-N-dinitroso-piperazine, N-nitroso-piperidine, and N-nitroso-N-methyl-acetamide was studied on Escherichia coli and Drosophila melanogaster and the results were compared with the mutagenic effects of x-radiation. The differences in the mutagenic effects of the urethane and acetamide were discussed at some length. (NSA 21: 1967, 22380)

1285 Whittinghill, M. BROOD DATA ON CROSSOVER RECOVERY FROM PRETESTED HEATED ADULT FEMALES. Drosoph. Inf. Serv. 39 (1964) 81.

Compared with inductions by x-rays (Whittinghill, Genetics 48: 1963, 915 and unpublished) the heat-induced* crossovers appeared at least 1 d earlier and possibly 2 or 3 d earlier than did viable x-ray induced crossovers. The partitioning of induction between gonial cells and early oocytes does not yet seem feasible. (From auth.)

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* 33°C.

See also:

937 Mutagenic effect of neutrons and x-rays on Drosophila melanogaster oocytes and oogonia. (Dickerman, R.L., 1966)

1008 Estimation of the rejoining distance for chromosome exchanges induced in Drosophila sperm by combined doses of x-rays and neutrons. (Heddle, J.A. et al., 1966)

1010 Genetic and direct effects of gamma radiation on Drosophila. (Ives, P.T., 1966)

1019 Genetic crossing-over in both sexes of Megaselia scalaris. (Mainx, F. et al., 1967)

1026 Interaction of x-ray and fast neutron-induced chromosome breaks in Drosophila. (Reddi, O.S., 1966)

1038 Genetical after-effects of x-rays depending on the temperature regime. (Tikhomirova, M.M. et al., 1967)

1052 Preserving food by radiation: safe or unsafe. (Anonymous, 1967)

1055 An increased yield of gamma induced eye colour mutations from chronic versus acute exposures in Dahlbominus. (Baldwin, W.F., 1967)

1122 Genetic effects of chronic γ-radiation on Habrobracon sperm. (Borstel, R.C. von. et al., 1967)

1134 The induction of dominant lethal mutations in insects by ionizing radiation and chemicals - as related to the sterile-male technique of insect control. (LaChance, L.E., 1967)

1152 Mutation pattern in two wild-type stocks of Drosophila melanogaster. (Strømnaes, Ø., 1959)

1174 Effects of x-rays, tryptophan metabolites, and eye colour mutants on the tumor-suppressor system in Drosophila melanogaster. (Brooks, G.T., 1967)

1186 RBE of fast neutrons by the release of mutations in Drosophila melanogaster. (Dauch, F. et al., 1966)

1209 Effect of conjugate aromatic systems on heredity. I. Mutagenic and antimutagenic effect of certain indene compounds. (Mosse, I.B. et al., 1964)

1301 Modification in productivity and mortality of flour beetle species and strains due to x-ray and the insecticide, DDT. (Erdman, H.E., 1966)

1308 Some effects of gamma radiation and apholate on the fertility of Drosophila melanogaster. (Henneberry, T.J. et al., 1967)

1410 Modification of fitness in species and strains of flour beetles due to x-ray and DDT. (Erdman, H.E., 1966)

1489 Induced mutations in polygenic systems. (Aastveit, K., 1966)

1562 A. The IAEA laboratory at Vienna and Seibersdorf. Second Report. IV. Agriculture. 8. Insect eradication and pest control. 5. Co-ordinated programme on insect eradication and sterile-male technique. (International Atomic Energy Agency, Vienna, Austria, 1965)

1620 Codling moth control. (Madsen, H.F. et al., 1967)

2.2. DEVELOPMENTAL AND PHYSIOLOGICAL EFFECTS ON THE ORGANISM

2.2.1. General Articles. Surveys

1286 Hungate, F.P. RESPONSE OF INSECTS TO RADIATION. p.2 of "Pacific Northwest Laboratory Monthly Activities Report, August 1966, on AEC Division of Biology and Medicine Programs". BNWL-322, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Sep. 1966, 18p.

Prior to chronic γ-radiation, flour beetle populations of single and mixed species were established at three temperatures and censused monthly for eight months as to larvae, pupae, and adults. From

the total number of bioforms observed it was clear that equilibrium was not attained during this period, possibly due to lack of homozygosity in the stocks. This was further suggested by a consistent difference in productivity in the several cultures which were presumed to be replicates.

1287 Lambrev, Z., Dushev, T. EFFECT OF IONIZING RADIATION x-RAYS ON THE SILKWORM (Bombyx mori). Nauchni Trud. vissh selskostop. Inst. Vasil Kolarov 14, 2 (1965) 179-182. (In Bulgarian, with German summary)

1288 Schlagbauer, A. RECHENPROGRAMME ZUR RATIONELLEN BESTIMMUNG DER EFFEKTIVEN UND BIOLOGISCHEN HALBWERTSZEIT BEI MESSUNGEN AN ÜBERLEBENDEN ORGANISMEN. (A method for computing the effective and biological half-life from measurements on surviving organisms.) G I T Fachztg Lab. No. 12 (1967) 1073-1080. Preprint. (In German)

The conditions are discussed which are necessary for an accurate determination of the effective half-life of living organisms. Reference is made to data obtained in tracer studies in entomology. The use of FORTRAN II calculating programmes for a rational and objective evaluation of experimental data is explained.

1289 Shipman, W.H., Cole, L.J. INCREASED RESISTANCE OF MICE TO x-IRRADIATION AFTER THE INJECTION OF BEE VENOM. Nature, Lond. 215 (1967) 311-312.

Subcutaneous injection of 5.6 µg bee, Apis mellifera ligustica, venom/g or intraperitoneal injection of a 1.1 µg/g dose into mice 24 h prior to x-irradiation (825 R) increased the survival from 0 - 80 and 20% respectively, by 30 d after the irradiation. Also, subcutaneous injection of 4.3 or 5 µg venom/g 1 d prior to exposure to x-irradiation (850 R) increased the 30-d survival from 0 - 70%, although these dosages were not effective in increasing survival when given 30 min prior to irradiation or injected immediately after the irradiation. The venom is placed in a different category from cysteine, AET, and related compounds which are effective when administered immediately prior to irradiation. At least three mechanisms may be invoked to account for the radioprotective effect of bee venom: (1) it has a stressor-like action, thereby eliciting an "adaptation syndrome," (2) it produces changes in the haemopoietic system, and (3) it has antibacterial properties. (CA 67: 1967, 61397q)

1290 Simón, F., García, B.G. EFECTOS DE LA RADIACIÓN GAMMA EN EL ARREBIATADO. (Effects of γ-radiation on the cotton stainer.) Boln Soc. ent. Agr. Perú 3 (1963) np.

The effects of γ-radiation on the Peruvian cotton stainer, Dysdercus peruvianus, were studied.

See also:

910 Biological Effects of Radiations. (Grosch, D.S., 1965)

2.2.2. Biochemistry. Physiology. Pathogen, Parasite, and Pesticide Susceptibility. Reproductive Potential

1291 Abdul Matin, A.S.M., Bhuiya, A.D., Khan, Z.A. AN ATTEMPT TO OBTAIN STERILITY OF MALE RICE Hispa THROUGH GAMMA RADIATION. p. 155-156 of "Proceedings of the Agricultural Symposium. Dacca, Pakistan, 13-14 May 1966". 1966, 186p.

Adult males of Dicladispa (Hispa) armigera (Ol.) were irradiated at various doses of γ-radiation from a ^{60}Co source at a fixed dose rate of 34.8 kR/h and placed in cages with untreated females. Records were kept of egg production, hatch, etc. When untreated virgin females were mated with irradiated males, the percentage of viable eggs decreased with increase in dose. The average egg hatch in the untreated controls was 71.49%, whereas matings with male beetles exposed to 10000, 8000, 7000, 6000 and 5000 R resulted in averages of 1.4, 1.41, 9.3, 12.72 and 14.50% egg hatch, respectively. (RAE-A 56: 1968, ref. 875)

1292 Akov, S. RETENTION OF THE BLOOD-MEAL IN Aedes aegypti FOLLOWING STERILIZATION BY CHEMICALS AND IRRADIATION. Ann. trop. Med. Parasit. 60, 4 (1966) 482-494.

A ^{60}Co source, type Gammacell-200, emitting 7760 R/min was used on 4-d-old A. aegypti. Blood meals were given on rats at various intervals after chemosterilant or irradiation treatment, in some cases sheep blood after chemosterilant treatment. Two days after the blood meal females were dissected in 0.85% NaCl, and the size of the blood residue in the mid-gut and the stage of ovarian development were determined. Both the chemosterilant and irradiation treatment cause a delay in blood digestion, not due to a lack of mid-gut protease. The effect of metapa, apholate and tepa on egg development was studied. The elimination of the blood meal was retarded in all females thus treated. A delay in blood digestion in the irradiated females was most obvious 48 h after feeding on a rat. The mid-gut proteolytic activity in females treated with chemosterilants or irradiation was not lower than in the controls. The retention of the blood meal was not due to an acute toxic effect, since it occurred also when the 1st blood meal was given 8 d after treatment. No delay in elimination of the blood meal was observed following the 2nd blood meal. The relationship between the retention of the blood meal and ovarian development is discussed.

1293 Becker, G. HOLZBESTANDTEILE UND HAUSBOCKLARVEN-ENTWICKLUNG. (Wood components and the development of the larvae of Hylotrupes bajulus.) Holz Roh-u. Werkstoff 21 (1963) 285-289. (In German, with English summary)

The following is virtually the author's summary. Larvae of H. bajulus (L.) utilize only a relatively small portion of the carbohydrates that are abundant in their food (about $^1/_3$ of the cellulose and $^1/_5$ of the hexosans and pentosans, total about 22%). The utilization of carbohydrates is variable. Larvae causing a high loss of wood by catabolism consume comparatively less wood than larvae with poor carbohydrate digestion. The degree of utilization of wood is somewhat affected by temperature. Certain doses of γ-radiation make cellulose better digestible for the larvae. The growth rate of the larvae depends directly on the protein content of the wood, which decreases from the phloem towards the inner parts of the trunk. In wood stored for some years, the lower limit is about 0.2% protein based on the weight of the wood. In softwoods of German origin, the protein content does not fall below this threshold. The nutritive value of wood for the larvae decreases gradually, although the nitrogen content does not fall. The unfavourable transformation of amino acids and reduction of vitamin B content affect mostly the younger larvae. By γ-radiation, the ageing-process of proteins is accelerated. The gradual impairment of nutritive conditions for Hylotrupes larvae, resulting in slow growth and longer generation periods as well as in a higher death rate, is of practical importance. Essential oils and resins inhibit the development of Hylotrupes larvae, but the pine-heartwood constituents pinosylvin and pinosylvinmonomethylether, which have a toxic effect on termites and certain fungi, have little effect. Among the heartwood constituents of other conifers, taxifolin and nootkatin showed no effect, but β-thujaplicin proved toxic. (RAE-A 54; 1966, 407)

1294 Bischkopf, R. DIE SPERMIOGENESE DER DROHNEN NACH BESTRAHLUNG DER JUNGLARVEN MIT VERSCHIEDENEN RÖNTGENDOSEN. (Spermatogenesis in drones following irradiation of the young larvae with various doses of x-rays.) Dt. ent. Z. 13, 1/3 (1966) 237-262. (In German)

1-2 d old larvae of drones of Apis mellifica mellifica L. and A. m. carnica Pollm. were irradiated with 610, 1000 and 2000 R. The effect on spermiogenesis was studied. Apart from the first 24 h after irradiation when a relatively high percentage of larvae were thrown from their cells for unknown reasons, there was no atypical behaviour of the workers towards the irradiated brood. Only one isolated deviation in development was observed in the pupal stage of the 2000-R batch. The occurrence of position inversion at the pupal stage of 610-R and 1000-R larvae was of interest. A comparison of the radiation effects on spermiogenesis was made histologically. No anomalies occurred in 610-R larvae, partially damaged testes occurred in 1000-R larvae, and complete malformation of the testis in 2000-R larvae.

1295 Catalan, R.E., Municio, A.M. IN VITRO EFFECT OF GAMMA-RADIATION ON DIFFERENT CHOLINESTERASE PREPARATIONS. Nature, Lond. 208 (1965) 1227.

Experiments were designed to investigate the in vitro effect of γ-rays on cholinesterase from various sources and of differing grades of purity. Irradiations were performed at 18°C in a thermostatically controlled cylindrical 2000 Ci ^{60}Co source. The dose-rate used was 2.5×10^5 R/h. Ten samples were simultaneously irradiated in sealed glass ampoules with a head space of 6 ml, containing air. Controls were handled in the same fashion, but they were not placed within the cobalt source. The preparations exposed to γ-radiation included bovine red blood cell cholinesterase preparations at

different stages of purification. These stages were: whole heads; homogenate; and a purified fraction. The enzymatic activities of the samples were controlled within 1 h of irradiation. Cholinesterase activity was measured potentiometrically using as substrate a solution of 0.5 M sodium chloride - 0.04 M magnesium chloride - 0.002 M acetylcholine bromide in 0.5 M phosphate buffer pH 7 and 38°C. The acetic acid liberated was automatically determined by titration with 0.005 N sodium hydroxide. Enzymatic activity was expressed as ml consumed alkali/min. The extent to which the pH of the samples was affected by the γ-irradiation was also determined. Experimental results were evaluated by plotting the percentage of the remaining enzymatic activity as a function of irradiation dose. Results indicate that the more purified the samples were, the more was the inactivating effect of the irradiation. In the cholinesterase preparations from common fly, the order of inactivation was: purified sample > homogenate > whole heads. Assays carried out with red blood cells and cholinesterase from the electric eel showed a high grade of inactivation. (NSA 20: 1966, 10586)

1296 Catalan, R.E., Municio, A.M. IN VITRO AND IN VIVO EFFECT OF γ-IRRADIATION OF COMMON FLY BRAIN CHOLINESTERASE. An. Fis. Quim. B 63, 12 (1967) 1145-1156.

The inactivation of cholinesterase by ^{60}Co radiation was dependent upon the purity and type of sample, with soluble enzyme being the most sensitive. Fly brain cholinesterase was the most radioresistant. Enzyme inactivation was slightly increased in freeze-dried homogenates by storage after irradiation. The converse was noted with brain homogenates. Increased inactivation was noted at pH values other than 6.5. The Michaelis constant was unchanged in irradiated brains, but V_{max} was inversely proportional to exposure. N,N-Dimethylcarbamate and 3-ethyl-4-methylsulfonyl O, O'-diethyl phosphate exhibited a significant radioprotective action at exposures to 8×10^5 R. (CA 68: 1968, 36459z)

1297 Drummond, R.O., Medley, J.G., Graham, O.H. ENGORGEMENT AND REPRODUCTION OF LONE STAR TICKS (Amblyomma americanum (L.) TREATED WITH GAMMA RADIATION. Int. J. Radiat. Biol. 10 (1966) 183-188.

Most unengorged nymphal lone-star ticks (Ambiyomma americanum (L.))exposed to 250-7500 R of γ-radiation from a ^{60}Co source engorged normally, and those irradiated with 1000 R or less moulted to adults; those irradiated with 2500 R or greater did not. Nymphs irradiated after completion of engorgement became increasingly tolerant to radiation during the moulting period. Those irradiated with 2500 R 1 d after engorgement did not moult, whereas those irradiated with 15 000 R two weeks after engorgement moulted. Egg-laying and egg hatch were used as criteria to determine the effects of radiation on the reproduction of adults from irradiated nymphs or irradiated adults. Irradiation with 250 R had little or no effect on reproduction. With females, reproduction was reduced at a dose of 500 R and prevented at a dose of 1000 R. With males, reproduction was slightly reduced at a dose of 500 R, and at a dose of 1000 R, effects on reproduction varied according to the point in development at which the males were irradiated. With both sexes, irradiation with 2500 R or more prevented reproduction. (Auth.)

1298 Ducoff, H.S. x-RAY RESPONSE OF AN ENDOPARASITIC WASP. Radiat Res. 27 (1966) 496. Abstr. BC-4. Presented at "14th Annual Meeting of the Radiation Research Society. Coronado, Calif., USA, 13-16 Feb. 1966".

Nemeritis canescens (Gravenhorst) is an ichneumonid parasite of larval microlepidoptera. Parasitised caterpillars show no early signs of injury, but continue to grow, and frequently pupate before death. Parasites hatch 3 d after oviposition (25°), proceed through 5 larval instars, and pupate about the 14th day. Adults emerge about 10 d afterwards, living about 10 d if fed, 3 d if starved. Only 1 parasite/host develops; any additional parasites are eliminated early in first instar, by fighting or by competition for O_2. Nemeritis-parasitised Anagasta larvae were x-irradiated at various stages of parasite development. With adult emergence as criterion of survival, the LD 50 of Nemeritis was, for 1st instar, 3.8 kR; 5th instar, 5.5 kR; pupae, over 8 kR. Adults exposed to 36 kR survived as long as controls, whether fed or starved. Six kR to 1st-instar Nemeritis completely suppressed adult emergence; 12 kR caused only slight mortality in unparasitised Anagasta larvae. Accordingly, Nemeritis were exposed to 6 or 12 kR during 1st instar; hosts were sacrificed at intervals, and the developing Nemeritis examined. Parasites exposed to 12 kR never moulted, exhibited marked decreases in feeding and in intestinal motility, and died in about 25 d; 6 kR larvae exhibited slight,

temporary decreases in feeding and intestinal motility, and developed, after considerable delay, to 5th instar, dying in 25-30 d. (Abstr.)

1299 Erdman, H. E. FAST NEUTRON IRRADIATION EFFECTS ON REPRODUCTION AND THE INFLUENCE OF TEMPERATURE AND SEX-EXPOSED ONE DAY-OLD FLOUR BEETLES, Tribolium castaneum Herbst. Paper presented at the "Meeting of the Entomological Society of Canada. Vancouver, B.C., Canada, 19-21 Oct. 1964".

Reproductive onset and productivity (F_1 adults/female) were determined for virgin day-old flour beetles irradiated with 830 rad of fast neutrons, mated in male-exposed, female-exposed, both-exposed and neither-exposed pairs and maintained at 25, 29 and 32°C in 70% r.h. Earlier reproductive onset and greater productivity were associated with increasing temperatures. Irradiation delayed reproductive onset for exposed female combinations and reduced productivity. Biological interpretations are discussed. (From abstr.)

1300 Erdman, H. E. x-RADIATION AND TEMPERATURE MODIFICATION OF REPRODUCTIVE PERFORMANCE OF SINGLE-SPECIES AND MIXED-SPECIES CULTURES OF Tribolium confusum AND Tribolium castaneum. Physiol. Zoöl. 39, 2 (1966) 160-170.

Adult flour beetles sexed as pupae and maintained separately for three weeks after adult emergence, were given 0, 1575, or 2625 R of x-ray. Single- and mixed-species populations were established and incubated at 25, 29, or 32°C at 65%-70% r.h. Productivity was determined during ten weeks post-irradiation. Reproductive abilities increased with increased temperature and decreased with increased x-ray exposure for a given temperature. The reproductive fitness of T. castaneum was superior in all environments except at 0 R, 32°C. The frequencies of dominant lethals (which included lethality due to coexistence in mixed-species populations) increased with higher x-ray doses, but temperature and cohabitation influenced their expression within a species. Coexistence was responsible for a considerable reduction of productivity, which was also altered by temperature and x-ray. The rigours of coexistence were lessened at 2625 R exposures (undoubtedly due to reduced population density). Interpretations of dose-response curves on the bases of "single-hit" and "multi-hit" radiation phenomena were inferred from similar responses of diverse organisms. Most lethality occurred in the early (eggs to young larvae) part of the life cycle for both species. Species proportions in coexistent populations varied with temperature and x-ray but T. castaneum was consistently superior compared to T. confusum. The greater variability of T. castaneum probably makes it more fit in environments, featuring different temperatures and x-radiation exposures plus coexistence. Responses to radiation of single-species populations cannot be used to predict those of mixed-species populations. (Auth.)

1301 Erdman, H. E. MODIFICATION IN PRODUCTIVITY AND MORTALITY OF FLOUR BEETLE SPECIES AND STRAINS DUE TO x-RAY AND THE INSECTICIDE, DDT. p. 78 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy, 26 Jun. - 2 Jul. 1966, 263p". Abstr. 305.

Productivity modifications due to radiation plus insecticides have important applications in economic entomology, evolution and radiation ecology. Such changes are known in some cases to have a genetic basis. Studies were designed to determine the early effects of DDT and x-radiation, singly and in combination, on mortality and productivity of flour beetle species and strains (Tribolium confusum Duval "Chicago standard" and T. castaneum Herbst "Brazil cl" and "Sooty").

For further details, see 1410.

1302 George, J. A. EFFECTS OF GAMMA RADIATION ON FERTILITY, MATING, AND LONGEVITY OF MALES OF THE ORIENTAL FRUIT MOTH, Grapholitha molesta (LEPIDOPTERA: TORTRICIDAE). Can. Ent. 99, 8 (1967) 850-857.

Male G. molesta (Busck) treated with 40 krad of γ-radiation in the late pupal stage reduced egg-hatch by 93.6%, and in the young adult stage by 96.4%, in eggs from untreated virgin females with which they were mated; in addition, hatched larvae failed to complete development. Induced sterility was consistently greater in treated adults as compared with treated pupae. Females in the late pupal stage were sterilized with about 10 krad. Male longevity decreased in proportion to the radiation dosage above 30 krad when caged at a ratio of 3 ♂: 1 ♀. Longevity of untreated males decreased in proportion to the number of females available for mating. Radiation levels of 30 krad

or more decreased male mating, especially when applied to the pupal stage, in inverse proportion to dosage, as detected by caging males with three times as many females. The number of matings per untreated male increased with the number of females available up to an average of 3.8 while the number of matings per female averaged approx. 1.6 with from one to three males per female. (Auth.)

1303 Glover, S.J. THE EFFECT OF IRRADIATION UPON O_2 UPTAKE IN SOME INSECTS. Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 113. Presented at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

The effect of irradiation upon O_2 uptake was investigated in the house fly, Musca domestica, and fall armyworm, Laphygma frugiperda. Pupae were irradiated at different levels, and emerging adults were tested at three ages. (Abstr.)

1304 Grosch, D.S. THE INFLUENCE OF ANTIBIOTICS ON THE FECUNDITY AND FERTILITY OF IRRADIATED Habrobracon FEMALES. Radiat. Res. 14, 4 (1961) 470-471. Abstr. 65. Presented at the "9th Annual Meeting of the Research Society. Washington, D.C., USA. 15-17 May 1961".

A concentric arrangement of ^{60}Co rods was used to deliver 4900 R to samples of virgin female braconid wasps. Some were given an acute dose delivered in 90 s, others received two 45-s fractions separated by 4 h of incubation. Both types of exposure resulted in a few days of infecundity after the eggs derived from preformed oocytes were deposited. Subsequently the difference in dose rate was reflected by striking differences in egg production. Refrigeration instead of incubation during the interfraction period allows no "recovery" or restoration. In order to identify important metabolic steps in the restoration process, chemical inhibitors have been employed. Chloromycetin and aureomycin, inhibitors of protein synthesis were detrimental to the recovery phase of Habrobracon egg production. They also lowered hatchability. Penicillin had no evident influence. This is consistent with Wolff's observations on the rejoining of radiation induced breaks in Vicia chromosomes. However the most potent agent, aureomycin, by itself decreased reproductive capacity. Furthermore, a shortened adult life span indicated a deleterious influence on non-dividing somatic tissue, presumably connected with interference with protein synthesis. In view of recent evidence that the insect ovary accepts protein from the blood rather than relying exclusively on the synthetic activity of its cells, interpretation of the primary effects of radiation at the cellular level may be obscured by alterations in somatic tissues involved in co-operative action with the insect ovary. (Abstr.)

1305 Grzelak, K., Lassota, Z. THE EFFECT OF γ-RAYS ON THE ACETYLCHOLINE LEVEL IN INSECTS. Bull. Acad. pol. Sci. Cl. II Ser. Sci. biol. 14 (1966) 391-395.

The diapausing pupae of Celerio euphorbiae were irradiated with a single 1000 kR dose of ^{60}Co γ-rays at a rate of about 200 kR/h. Within 2 h after irradiation the lethargic pupae as well as non-irradiated control ones of similar weight (1.9 ± 0.2 g) were bled, sectioned, and the fat body was discarded. The residual tissues were separated from the cuticula and immediately plunged into 10% trichloroacetic acid. The average wet weight of tissues to be analysed, prepared from 1 g of whole pupa was about 0.22 g. Tissues from three individuals were usually collected in 4 ml of 10% trichloroacetic acid and the mixed sample was homogenized in a glass homogenizer. The eggs of Bombyx mori were irradiated at diapause with a single dose of 20 kR of ^{60}Co γ-rays at a rate of about 200 R/min. At a given stage of embryogenesis 1 g of eggs was homogenized in 4 ml of 10% trichloracetic acid. The quantities of acetylcholine in the homogenates were determined colorimetrically after separation on paper chromatograms. Irradiation caused an immediate increase in acetylcholine content of pupal tissues and a delayed increase of acetylcholine in irradiated eggs was correlated with the differentiation of the nervous system of the embryo. (NSA 20: 1966, 42874)

1306 Hart, W.G., Ingle, S. INFLUENCE OF RADIATION ON THE FECUNDITY OF THE BROWN SOFT SCALE. Bull. ent. Soc. Am. 12 (1966) 265. Abstr. 339. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

3rd-stage brown soft scale, Coccus hesperidum L., were subjected to dosages of 5000, 10 000, 20 000, and 40 000 R from a ^{60}Co-source. The scales were attached on Mexican squash, Cucurbita moschata, when exposed. No offspring were produced at the two higher dosages and reduced numbers at the lower dosages. (Abstr.)

1307 Hathaway, D.O. LABORATORY AND FIELD CAGE STUDIES OF THE EFFECTS OF GAMMA RADIATION ON CODLING MOTHS. J. econ. Ent. 59, 1 (1966) 35-37.

γ-radiation of the codling moth, Carpocapsa pomonella (L.), as an adult or fully mature pupa reduced the F_1 generation 98% when male moths treated with 40 kR were mated with untreated female moths. Treated female moths irradiated with 20 kR and mated with untreated males deposited no viable eggs. The population reduction in the F_1 generation was 84% when adult males treated with 40 kR were confined in field cages at a ratio of 20 treated males to one untreated male and one untreated female moth. The reduction of the F_1 generation was slightly lower, 76%, when both the adult females and males treated with 40 kR were released in field cages at a ratio of 20 treated males and 20 treated females to one untreated male and one untreated female moth. (Auth.)

1308 Henneberry, T.J., Mason, H.C., McGovern, W.L. SOME EFFECTS OF GAMMA RADIATION AND APHOLATE ON THE FERTILITY OF Drosophila melanogaster. J. econ. Ent. 60, 3 (1967) 853-857.

Untreated female D. melanogaster Meigen mated to irradiated or apholate-fed males produced about the same number of eggs as females of untreated pairs. Most of the eggs laid by females mated to irradiated or apholate-treated males were nonviable. None of the eggs laid by nine virgin females, three each mated 1-, 5-, or 10 d after treatment to a sterilized male, produced adult flies. Irradiated or apholate-fed females laid fewer eggs, most of which were not viable, than females of untreated pairs. The age of males or females when treated appeared to have little effect on results obtained after radiation exposure. Apholate appeared to induce a higher degree of sterility when males or females were older at the time of treatment. When females producing fertile eggs were mated to irradiated (16 kR) males, adult emergence was markedly reduced. Females mated first to irradiated (16 kR) males produced nonviable eggs. Subsequent mating with untreated males resulted in the production of fertile eggs. (Auth.)

1309 Jones, R.H. SOME IRRADIATION STUDIES AND RELATED BIOLOGICAL DATA FOR Culicoides variipennis (DIPTERA: CERATOPOGONIDAE). Ann. ent. Soc. Am. 60, 4 (1967) 836-846.

The following is virtually the author's abstract. In investigations in Texas, laboratory-reared examples of C. variipennis (Coq.) were treated with γ-radiation as larvae, pupae and newly emerged adults at doses of 5000, 10 000 and 15 000 R and as pupae at 20 000 and 30 000 R. The criterion for sterility of males was the reduction in the hatching of eggs deposited by untreated females with which they mated. With few exceptions, 95-100% of the males treated at doses above 5000 R were sterile in first matings, but males treated at all levels tended to recover fertility in later matings. Recovery decreased as the radiation dose increased, but even a dose of 30 000 R failed to prevent recovery entirely. Treated females did not recover and rarely laid more than one egg batch, though those batches that were laid often had rather low percentages of sterility. With treated females, the number of eggs per batch decreased as the radiation dose increased, until at 30 000 R no eggs were laid. Miscellaneous biological information on the laboratory colony, principally relating to reproductive performance, was obtained in testing the treated insects and the accompanying controls. (RAE-B 56: 1968, ref. 6)

1310 Kalmykov, P.G. CHANGE OF OXIDATIVE PROCESS IN INSECTS UNDER THE INFLUENCE OF γ-RAYS. Radiobiologiya 5, 4 (1965) 505-510.* (In Russian)

Respiratory activity was studied. The irradiation of winged flies (at the egg, larval and pupal stages), with 100 - 3000 R γ-rays lowered oxygen intake which remained at that level throughout metamorphosis and persisted in their progeny, regardless of the stage in the life cycle at which irradiation took place. When irradiation was combined with treatment with hydrogen cyanide, this modification in respiratory activity was not so marked. It would appear that γ-irradiation significantly affects the cytochrome oxidase.

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* Also presented at the Fourth Conference on Endemic Diseases and Parasitological Problems of Khazakhstan and the Republics of Middle Asia, and at the Third Conference of Parasitologists of the Ukrainian Republic.

1311 Kang, Y. S., Cho, W.K., Kim, Y.J., Lee, C.C. ON THE RATE OF LAYING OF EGGS AND ADULTING IN D. melanogaster INDUCED BY x-RAYS. J. nucl. Sci., Korea 4 (1964) 64-68. (In Korean, with English summary)

The effects of radiation on the fecundity and the fertility of D. melanogaster were studied. The males were more susceptible to reduction in fertility than the females but the females recovered fertility sooner than the males in the 3000 R-irradiated mating groups. The results obtained are summarized in tabulated form, giving the mean numbers of eggs laid and percentages of eggs to become adult per female in 30 d.

Mating groups	Numbers of eggs laid	Percentages of eggs to become adult
Control	953 984	76.520
$F^T \times M^N$	126 271	42.062
$F^N \times M^T$	824 639	8.245
$F^T \times M^T$	122 428	27.051

1312 Pulitzer, J.F. x-RAY-INDUCED MUTABILITY OF POLYGENES CONTROLLING HATCHING TIME IN Drosophila melanogaster. Mutation Res. 3 (1966) 158-166.

Hatching time is a suitable parameter for the study of polygenic x-ray induced mutations in D. melanogaster in the heterozygous state. Because eggs are relatively closed systems until the moment they hatch, many environmental complications are avoided. Moreover, by means of paired observations it is possible to measure minute changes in hatching time and thus to discern mutations with very small metrical effects. Eggs of nonirradiated females inseminated by irradiated males were studied. Analysis of the results by Bateman's method indicated that the min. incidence of mutations in sperm was about 26% at 1200 R and 49% at 2400 R. The mean metrical effect of each mutation was to retard hatching time by about 24 min. By this method it is not possible completely to exclude the possibility of some non-genetic physiological component of the changes observed. However, it seems rather unlikely that such a component will be significant to any great extent. (Auth.)

1313 Quraishi, M.A.H., Kershaw, W.E. THE EFFECT OF x-IRRADIATION ON THE SURVIVAL OF Liponyssus bacoti AND ON ITS SUSCEPTIBILITY TO INFECTION WITH Litomosoides carinii. Ann. trop. Med. Parasit. 60, 1 (1966) 57-62.

The following is based largely on the authors' summary. The results are given of experiments at Liverpool on the effect of x-irradiation on the survival of Ornithonyssus (Liponyssus) bacoti (Hirst) and on the development of L. carinii in it. Irradiation at 50 000-150 000 rad decreased survival of the mites in direct proportion to dosage. When batches of mites were irradiated at 90 000 rad 24 h before the infective feed, more infective larvae of L. carinii developed in the few mites that survived 15 d after irradiation than did in the much larger number of untreated mites that lived for 15 d. However, when the number of larvae developing was expressed in relation to the original numbers of mites used, the irradiation of the mites before they acquired their infection reduced the number of infective parasites developing to about half that in the unirradiated mites; irradiation 24 h after the infective meal effected a reduction to one-tenth. (RAE-B 55: 1967, ref. 441)

1314 Rockstein, M., Srivastava, P.N. TREHALOSE IN THE FLIGHT MUSCLE OF THE HOUSE FLY, Musca domestica L., IN RELATION TO AGE. Experientia 23, 8 (1967) 636-637.

At the end of the paper mention is made of some work in progress on the effects of x-irradiation at the early pupal stage on trehalose content and metabolism. No results are given.

1315 Sato, C., Sasaki, S., et al. EFFECTS ON x-RAYS ON RESPIRATION OF Sarcophaga PUPAE. Nippon Igaku Hoshasen Gakkai Zasshi (Nippon Acta radiol.) 26, 9 (1966) 1180-1183. (In Japanese)

The amount of O-consumption of pupal Sarcophaga which proved age-specific follows a U-shape curve of respiration; the ascending part was inhibited by x-rays during the latter half of the pupal stage. When measured on the 8th day of pupal life, inhibition of respiration varied with the dose and the age at it was given. Within 24 h of puparium formation, respiration appeared very sensitive

to inhibitory effects of radiation but quite insensitive when irradiated on the 4th day of pupal development. Components sensitive to respiration decreased and the mean effective dose of inhibition increased exponentially with age (0-4 d). During this period, the fraction of isolated myoblasts in muscle tissue also decreased with age. The inhibition of respiration of 1-d-old pupae was significantly related to the decrease in protein in the giant mitochondria of flight muscle. (Based on NSAI 6: 1967, 43347)

1316 Shrivastava, S.C., Richards, A.G. AN AUTORADIOGRAPHIC STUDY OF THE RELATION BETWEEN HEMOCYTES AND CONNECTIVE TISSUE IN THE WAX MOTH, Galleria mellonella L. Biol. Bull. mar. biol. Lab., Woods Hole 128 (1965) 337-345.

The haemocyte count of G. mellonella during the prepupal and early pupal stages varies from 4000/mm^3 to 15 000/m^3 as a function of age. The number of freely circulating cells can be approx. doubled within 6-24 h by bleeding the insect. Using ^{3}H-thymidine and autoradiography it was found that there is a haemocyte differentiation sequence of prohaemocyte → plasmatocyte → adipohaemocyte. This differentiation requires about 3 d at 35°C, and the labelled cells have disappeared in another 3 d. The life expectancy of these cells, at least in prepupal and early pupal stages, is then less than 6 d. Transfusion of labelled haemocytes, followed by autoradiography of sections, confirmed the previous suggestion that adipohaemocytes have some role in the destruction of the larval neural lamella, but that no blood cells are involved in the formation of the connective tissue around the adult nervous system. (Auth. summary)

1317 Smith, J.C. STUDIES IN THE USE OF IONIZING RADIATION AS STIMULI. Progress Report, June 1, 1965-May 31, 1966. ORO-2903-28, Florida State Univ., Tallahassee, Dept. of Psychology. 30 May 1966, 10p.

Investigations of visibility curves of a variety of insects and preliminary studies on the sensitivity of the moth eye to β-particles and visible light are among the studies reported.

1318 Torossian, C., Causse, R. ETUDE EXPERIMENTALE DE LA LEVEE DE L'INHIBITION DE LA PONTE DES OUVRIERES DE LA FOURMI Dolichoderus quadripunctatus ELEVEES EN PRESENCE DE REINES AYANT SUBI UNE FORTE IRRADIATION γ. C.r. hebd. Séanc. Acad. Sci., Paris 264 (1967) 2789.

Les reines, ayant subi une forte irradiation aux rayons γ (50 000, 75 000 et 100 000 rd en une seule exposition, respectivement, avec une précision de 2,5%, d'un irradiateur au ^{60}Co de 2000 Ci, au débit de dose de 1040 rd/min), ne peuvent plus maintenir l'inhibition totale de la ponte des ouvrières de leur colonie. Il semble que ce résultat soit imputable à la modification du rythme de ponte de la reine. C'est la première fois qu'on observe chez cette espèce, la ponte simultanée des ouvrières et de la reine.

1319 Vereecke, A., Pelerents, C. THE INFLUENCE OF DOSE-RATE OF GAMMA-IRRADIATION ON THE REPRODUCING CAPACITY OF ADULT FEMALES OF Tribolium confusum Duval. Mede. Landb. Hoogesch. Opzoeklstus Gent 32, 3/4 (1967) 890-903. (In English with Flemish, French and German summaries)

Adult females were exposed to γ-rays of high dose rate (234 krad/h) and of low dose rate (17.3 krad/h). The doses varied by 500 rad from 3500 - 5000 rad. Fecundity and fertility were controlled for a month. The fecundity was somewhat greater at the low dose rate whereas the fertility was not influenced by the dose rate . (Essentially auth. summary)

1320 Walker, J.R. REPRODUCTIVE POTENTIAL OF THE SWEETPOTATO WEEVIL AFTER EXPOSURE TO IONIZING RADIATION. J. econ. Ent. 59 (1966) 1206-8.

When male sweetpotato weevils, Cylas formicarius elegantulus (Summers) were exposed to 18 000 R of γ-rays and then mated with untreated virgin females, egg hatch was reduced to < 1%. Irradiated males competed favourably with untreated males. Matings involving four sterile males, four untreated males, and four untreated virgin females had an average of 55% egg hatch. There was no subsequent reduction in the number of progeny produced when virgin females were first mated with untreated males and later with irradiated males. Radiosensitivity decreased as the age of the weevils increased. The average reproductive life span for the weevil is ~ 67 d for males, and 80 d for females, with an

average of 2 progeny/female/d. Irradiation shortened the life span but not to any disadvantage in this case since adult feeding causes serious damage. The utilization of a sterile-male approach is discussed. A water-filled ^{60}Co-pit was used as source, the material to be irradiated being placed in an air-tight diving bell and lowered into the pit.

1321 Yanders, A.F. THE RELATIONSHIP OF GENETIC DAMAGE TO INSEMINATION SUCCESS IN x-RAYED Drosophila SPERM. AED-Conf-226-4, Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany). 1966, 1p.

For abstract, see 1322.

1322 Yanders, A.F. THE RELATIONSHIP OF GENETIC DAMAGE TO INSEMINATION SUCCESS IN x-RAYED Drosophila SPERM. p. 238 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun. - 2 Jul. 1966, 263p". Abstr. 948.

The success of sperm in reaching and being retained in the storage organs of female D. melanogaster is measurably reduced if the males are irradiated prior to mating. This is possibly due to physiological damage resulting in a reduction of motility, and raises the question of whether radiation-induced physiological damage is correlated with genetic damage. To test this, males aged 1, 7, or 14 d, were irradiated with 4500 R of 250 kVp x-rays, and pair mated to two virgin females at 24 h intervals for eight mating periods. One of each pair of females was dissected and scored for insemination success; the second was permitted to produce progeny, which were counted, sexed, and examined for induced Minute mutations. Daily values were obtained for all parameters. A reduction in insemination success, noted in all treated groups, is related to the age of the male and the mating period. The reduction in progeny number/male/d follows the same trend as the reduction of insemination success, and no definite trend is seen in the recovery of Minutes. These data are consistent with the hypothesis that genetic and physiological damage are not correlated, but occur as independent events in sperm populations. (Abstr.)

See also:

102 Mutational response of the premeiotic germ-cell stages of adult Drosophila melanogaster males to x-irradiation. (Puro, J., 1966)
917 Note on the relative sensitivity to irradiation damage in homozygous and heterozygous Drosophila melanogaster with regard to their capacity of producing offspring. (Bonnier, G., 1959)
923 Nucleic acids in normal and γ-rays irradiated eggs of Bombyx mori. (Lassota, Z., 1967)
959 Fifth report from Norsk Hydro's Institute for Cancer Research for 1963-1964. (Norsk Hydro's Inst. for Cancer Research, Oslo, 1965)
963 Techniques for studying the effects of radiation on meiosis and related processes in mosquitoes with particular reference to Aedes aegypti. (Rai, K.S., 1968)
966 Cell and mitotic patterns of the regenerating germ core of Gryllus domesticus in controls and after irradiation. (Schwalm, F.E., 1965)
1078 x-Ray induced minutes in Drosophila melanogaster sperm ejaculated in consecutive matings. (Kvelland, I. et al., 1965)
1101 On the biological effect of high-energy protons. (Saksonov, P.P. et al., 1965)
1104 Genetic segregation in the unisexual wasp Devorgilla. (Speicher, B.R. et al., 1965)
1123 Effectiveness of sterilization of the mallow moth: irradiability at different stages of development, and certain features of mating and egg-laying. (Buginsky, V.I., 1963)
1124 Sterilization of the male alfalfa weevil (Hypera postica: Curculionidae) by x-radiation. (Burgess, E.E. et al., 1966)
1125 Sterilization of the female adult of Nauphoeta cinerea (Blattoidea) by means of x-rays. (Caprotti, M. et al., 1963)
1127 Radiation sterilization studies on the tobacco budworm, Heliothis virescens Fab. (Flint, H.M., 1966)
1131 Sterilization of the coffee leaf miner. (Katiyar, K.P., 1967)
1132 Sterilization of parasites of the ash tree. (Khvatova, L., 1965)
1141 Laboratory studies to sterilize the boll weevil with radiation. (Mayer, M.S. et al., 1966)
1153 Some effects of gamma radiation on navel orange-worm, Paramyelois transitella (Walker). (Subrahmanyam, U., 1967)

1166 The pathogenic effect of small and average doses of gamma-rays on future generations of irradiated insects. (Podolyan, V.Y., 1964)

1192 Effects of dimethyl sulfoxide (DMSO) on productivity of x-rayed flour beetles. (Erdman, H.E., 1965)

1256 A comparison of the sterilizing effect of x-rays, quinacrine mustard and azaserine on Drosophila males. (Browning, L.S. et al., 1965)

1278 Stock differences in x-ray mutational sensitivity pattern of Drosophila melanogaster. (Strømnaes, Ø., 1959)

1338 Observations on the behaviour of pupae of Hyphantria cunea irradiated with γ-radiation. (Boguleanu, G., 1965)

1341 A study of the life history and the effect of radiation on rice weevil Sitophilus oryzae L. (Chettachai Baditsing, 1966)

1342 Gross effects of gamma radiation on the Indian-meal moth and the Angoumois grain moth. (Cogburn, R.R. et al., 1966)

1354 Stérilisation de la mouche méditerranéenne des fruits, Ceratitis capitata Wied., par irradiation des pupes aux rayons gamma. (Féron, M., 1966)

1355 Gamma irradiation of pupae of the tobacco budworm. (Flint, H.M. et al., 1967)

1356 The effect of gamma irradiation on the Varo race of Bombyx mori L. II. Irradiation of eggs in the early and late embryonic stages. (Gubicza, A. et al., 1964)

1361 The susceptibility of the different stages of rice weevil, Sitophilus oryzae L. to gamma radiation. (Khan, Z.A. et al., 1967)

1363 The delayed death of 20 kR gamma rays irradiated embryo of Bombyx mori. (Lassota, Z., 1966)

1364 Effects of x-rays on the larva at the fourth stage of Anopheles maculipennis atroparvus. (Lecis, A., 1963)

1365 Cobalt-60 radiation studies with the European chafer. (Lippold, P.C. et al., 1966)

1366 Sterilization of onion maggots by irradiation with cesium-137. (McClanahan, R.J. et al., 1966)

1371 Determination of the dorsal mesothoracic disc in Drosophila. (Murphy, C.G., 1967)

1376 Effects of sub-lethal gamma radiation on the biology and behaviour of the Angoumois grain moth, Sitotroga cerealella Olivier. (Qureshi, Z.A., 1966)

1379 Gamma irradiation of European corn borer larvae. (Raun, E.S. et al., 1967)

1386 Biochemical and developmental response of grasshopper embryos and spermatogonia to x-irradiation. (Tahmisian, T.N., 1965)

1388 Récentes expériences de radiobiologie sur Bombyx mori. (Teulade, P., 1966)

1390 Effect of gamma radiation on Trogoderma glabrum and Attagenus piceus. (Tilton, E.W., et al., 1966)

1397 Effects of gamma radiation on development of Dermacentor occidentalis (Ixodidae). (Ziad Al-ahmadi, A., 1967)

1410 Modification of fitness in species and strains of flour beetles due to x-ray and DDT. (Erdman, H.E., 1966)

1412 Effect of ionizing radiation on the survival rate of Agrotis segetum Schiff, and its ability to breed. (Khakimova, R.K., 1964)

1431 Radiation sterilization of the black blow fly. (Bushland, R.C., 1966)

1439 Radiation studies with the boll weevil: lethal effects on larvae, pupae, and adults; male sterility and dose fractionation. (Flint, H.M. et al., 1968)

1455 Effects of dimethylsulfoxide on productivity of x-irradiated flour Beetles. (Erdman, H.E., 1966)

1456 The combined effects of irradiation, vibration, and centrifugation on braconid fecundity, fertility and life span. (Grosch, D.S., 1966)

1457 Utilization of Habrobracon and Artemia as experimental materials in bioastronautic studies. Status Report, Jan.-June 1965. (Grosch, D.S., 1965)

1471 The effects of gamma radiation on mating competitiveness and fecundity of Hippelates pusio Loew. (Flint, H.M., 1968)

1477 Mating competition of gamma-irradiated and nonirradiated male Trogoderma glabrum Herbst. (Tilton, E.W. et al., 1966)

1668 Food irradiation research and pilot facilities in operation or planned in India. (Kumta, U.S. et al., 1966)

1699 Effects of gamma irradiation on the longevity and fertility of five species of stored-product insects. (Watters, F.L., 1966)

1323 Baker, W.K. A CLONAL SYSTEM OF DIFFERENTIAL GENE ACTIVITY IN Drosophila. Devl Biol. 16, 1 (1967) 1-17.

The patterns of eye pigment variegation in 2 cases of position effect (one in D. virilis and the other in D. melanogaster) were laid down in the imaginal eye disk during the end of the 1st larval instar. The timing of this determinative event was made possible by comparing the variegation patterns with the size and shape of twin spots in the adult eye formed by the x-ray induction of somatic exchange at the end of the 1st instar. In D. virilis, the variegation patterns and the twin spots were compared in different flies; whereas, in D. melanogaster, a scheme was devised so that the comparison could be made in one and the same eye. The variegation pattern was clonal; therefore, the information contained in this determinative event was passed on to the daughter somatic cells for a number of cell generations until the differentiation of the eye was complete and pigment synthesis initiated. Although growth was markedly inhibited in larvae fed on a medium containing actinomycin D during the 1st instar, such treatment did not affect the pattern of position-effect variegation. (CA 67: 1967, 30174k)

1324 Broce, A.B., Goldman, L.J., Cromroy, H.L. RADIOSENSITIVITY OF COCKROACHES. Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 111. Presented at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Seven different species of cockroaches were tested for verification of the "Sparrow Hypothesis". The endothelial cell of the midgut was used as the radiosensitive indicator. Positive correlation with Sparrow's work on plants was obtained. (Auth.)

1325 International Atomic Energy Agency, Vienna (Austria). A CYTOLOGICAL STUDY OF THE EFFECTS OF RADIATION ON THE DEVELOPMENT OF THE REPRODUCTIVE ORGANS OF TWO SPECIES OF FRUIT FLIES, Dacus oleae AND Ceratitis capitata; PART OF A CO-ORDINATED PROGRAMME OF INSECT CONTROL USING RADIATION. Research contract 169. p. 79-81 of "IAEA Research Contracts. Seventh Annual Report". Technical Reports Series No. 74. Vienna, International Atomic Energy Agency. 1967. 223 p. STI/DOC/10/74.

Research Institution: Laboratory of Agricultural Entomology, University of Florence, Florence, Italy.
Principal scientific investigator: B. Baccetti.
Period of contract: 20 Dec. 1962 - 19 Dec. 1965.

1326 Larsen, W. SURVIVAL OF IRRADIATED INSECT HEART FRAGMENTS FOLLOWING TREATMENT WITH PROPYL GALLATE. Proc. Utah Acad. Sci. 42, 1 (1965) 53-55.

The use of an organ culture to evaluate the action of ^{60}Co on survival time of insect tissues treated with propyl gallate was tested on heart fragments from embryos of the ovoviviparous roach, Blaberus craniifer. The developmental period for these embryos is ~3 months. 56 fragments (4 hearts/vial) were exposed to 82 000 rad of γ-rays at room temperature, which served as controls, a 2nd group of 36 fragments to 44 000 rad. Survival time at this level was ~16 d. Various concentrations of propyl gallate were tested. Propyl gallate proved to have radioprotective value. It extended survival time to 100% at the higher, and 66% at the lower level of irradiation. High concentrations of propyl gallate have a toxic effect on the tissues. In the 1st series, with a concentration of 0.0231 g/150 ml, only 70% of the fragments recovered and recovery time was slowed down. In the 2nd series, 100% recovered, with a lower concentration of propyl gallate. Propyl gallate is an antioxidant. Its protective action is discussed.

1327 Little, H.F. MIDGUT EPITHELIUM OF ADULT Chelisoches morio (DERMAPTERA: CHELISOCHIDAE) AND Ceratitis capitata (DIPTERA: TEPHRITIDAE) FOLLOWING IONIZING IRRADIATION. Ann. ent. Soc. Am. 60, 2 (1967) 412-414.

The midgut epithelium of a species of earwig, Chelisoches morio (F.), and of the Mediterranean fruit fly, C. capitata (Wiedemann), were found to be rather normal in appearance following exposure to 10 000 R (x-rays) and 10 000 rad (γ-rays) respectively. This phenomenon is in contrast to the severe damage to mammalian small intestine resulting from a dose only $^1/_{10}$ as great. Since there is good reason to believe that mitosis is important in maintenance of the midgut epithelium in both insect

species, the radioresistance of this epithelium implies considerable radioresistance on the part of the regenerative cells. (Auth.)

1328 Mortreuil-Langlois, M. EFFET DES RAYONS X SUR L'INTESTIN MOYEN DE Blabera fusca Br. C. r. Séanc. Soc. Biol. 154 (1960) 1769-1770.

The appearance of radiolesions of the mucous membrane of the middle intestine was studied in B. fusca (Orthoptera) irradiated with a dose of 25 000 R. The most radiosensitive cells are the regeneration cells at the moment of their differentiation in secretor elements. The irradiation does not suppress the secretion of epithelial cells. (Tr-auth., NSA 15: 1961, 17940)

1329 Mortreuil-Langlois, M. ETUDE HISTOPATHOLOGIQUE DE L'INTESTIN MOYEN DE Blabera fusca Br. (ORTHOPTERE) AU COURS D'UNE PERIODE PROLONGEE DE POST-IRRADIATION. (Histopathological study of the midgut of Blabera fusca Br. (Orthoptera) over an extended post-irradiation period.) Bull. Soc. zool. Fr. 88 (1963) 539-546. (With French summary only)

L'étude histopathologique du mésentéron chez l'Orthoptère Blabera fusca Br. irradié par les rayons X à la dose de 10.000 rads, a montré que: 1) les cellules épithéliales sont plus sensibles à l'action des radiations ionisantes que les fibres musculaires; 2) une augmentation de la résistance aux rayons X des cellules épithéliales apparaît au cours de leur différenciation cellulaire en éléments fonctionnels. A ce stade, les radiolésions morphologiquement décelables évoluent réversiblement; 3) des pycnoses apparaissent de plus en plus nombreuses dans les premiers jours de post-irradiation entraînant un dépeuplement des cryptes de régénération. La restauration se fait par division mitotique à partir du milieu de la deuxième semaine. (From auth.)

1330 Perez-Davila, Y., Baker, W.K. EFFECT OF ACTINOMYCIN D ON THE DEVELOPMENT OF THE EARLY IMAGINAL EYE DISKS OF Drosophila melanogaster. Devl Biol. 16, 1 (1967) 18-35.

The effect of actinomycin D (I), on the development of the imaginal eye disks was studied. I was placed in the food at 10 μg/ml during the 1st and 2nd instar. Histological studies indicated that the head anlagen of treated larvae (which weighed 30% as much as the control larvae) were somewhat smaller at the end of the 1st instar, although they contained the same number of cells. Cell division during the 1st instar was not affected by I. During the 2nd instar, all cell division ceased in the treated anlagen, while these cells in control larvae underwent three divisions. This was an abrupt change in sensitivity to I since anlagen of larvae on normal food during the 1st instar completely stopped cell division when placed on I-containing food at the end of this instar. The fate of the presumptive eye cells within the head anlage was determined by measuring the frequency and size of twin spots produced in the adult eye resulting from x-ray-induced somatic crossing-over. I-treated and control larvae were irradiated at the end of the 1st or at the end of the 2nd instar. No relevant difference was observed between the control and I series in the frequency of twin spots or in their size when the somatic crossing-over was induced at the end of the 2nd instar. The counts of cell numbers during the 2nd instar indicated no cell division in the I-treated anlagen, but three cell divisions in the control anlagen. I probably blocked cell division during the 2nd instar but allowed the chromosomes to replicate, and the chromosomes were subsequently distributed normally to the cells formed when cell division resumed upon removal of the larvae from the I-containing food. (CA 67: 1967, 51524f)

1331 Riemann, J.G., Flint, H.M. IRRADIATION EFFECTS ON MIDGUTS AND TESTES OF THE ADULT BOLL WEEVIL, Anthonomus grandis, DETERMINED BY HISTOLOGICAL AND SHIELDING STUDIES. Ann. ent. Soc. Am. 60, 2 (1967) 298-308.

Histological studies demonstrated that radiation doses considerably below those required for sterilisation killed most regenerative cells of boll weevils, A. grandis Boheman, which resulted in the loss of most or all of the secretory epithelium. Extensive damage to midgut was noted in one specimen that received 2000 R and in all those given 4000 R. Shielding experiments showed that when only the head and that part of the thorax anterior to the midgut were irradiated, mortality did not exceed that of the control. Irradiation over the abdomen and the posterior part of the thorax produced the same level of mortality as did whole-body irradiation. These findings indicate that damage to the midgut is the basic cause of the high mortality among weevils given sterilising doses of radiation. At 10 d after irradiation, no spermatogonia were found in any testes irradiated with 6000 R or more, and none were found in some testes that received only 2000 R. (Auth.)

1332 Shen, S.K., Berryman, A.A. THE MALE REPRODUCTIVE SYSTEM AND SPERMATOGENESIS OF THE EUROPEAN PINE SHOOT MOTH, Rhyacionia buoliana (LEPIDOPTERA: OLETHREUTIDAE), WITH OBSERVATIONS ON THE EFFECT OF GAMMA IRRADIATION. Ann. ent. Soc. Am. 60, 4 (1967) 767-774.

The morphology of the male reproductive system of R. buoliana (Schiffermüller), the European pine shoot moth, and the process of spermatogenesis are described. Spermatozoa were first observed in 2-d pupae and the reproductive system was fully formed in 11-d pupae. The gonadal tissue of males irradiated with 36 000 and 54 000 rad as 11-d pupae and as adults was compared with that of untreated individuals. Irradiation caused increased tracheolation of the testicular epithelium, thickening of the walls of the seminal vesicles, dispersion of the spermatocytes from their peripheral location, degeneration of sperm bundles, and vacuolation of the testes. (Auth.)

See also:

927 A cytological study of radiation effects in testes of the screw-worm fly, Cochliomyia hominivorax (Diptera: Calliphoridae). (Riemann, J.G., 1967)
948 Effect of gamma rays on development of the sex cells in the beet fly. (Klimtnya, A.Y., 1965)
955 Analysis of genetic sensitivity to x-rays of ovaries of Drosophila melanogaster. (Morey, M., 1965)
972 Dose rate effect of radiation on spermatogonia of the silkworm. (Sugai, E. et al., 1967)
1305 The effect of γ-rays on the acetylcholine level in insects. (Grzelak, K. et al., 1966)
1318 An autoradiographic study of the relation between hemocytes and connective tissue in the wax moth, Galleria mellonella L. (Shrivastava, S.C. et al., 1965)
1335 A cytological study of the effects of radiation on the development of the reproductive organs of two species of fruit flies: Dacus oleae and Ceratitis capitata. Report No.7 (Final), Dec. 20, 1962 - Dec. 19, 1965. (Baccetti, B., 1962/1965)
1388 Récentes expériences de radiobiologie sur Bombyx mori. (Teulade, P., 1966)
1401 Intestinal damage and water imbalance in gamma-irradiated larvae of Bombyx mori. (Lassota, Z., 1966)
1402 Reversal of heterochromatization and the activity of the paternal chromosome set in the male mealy bug. (Nur, U., 1967)

2.2.4. Developmental Stage Response. Delayed Development

1333 Asman, M., Rai, K.S. RADIOSENSITIVITY OF THE YELLOW-FEVER MOSQUITO, Aedes aegypti. Proc. Indiana Acad. Sci. 75 (1965) 109.

1334 Auerbach, S.I., Crossley, D.A., Jr., Shinn, A.F. POSTATTACK INSECT PROBLEMS. p.137-142 of "Proceedings of the Symposium on Postattack Recovery from Nuclear War. Fort Monroe, Va., USA, 6-9 Nov. 1967".

These problems are essentially radiological or ecological. Radiological problems include β-dose response, life-cycle or radiation profile, and comparative radiosensitivity; ecological problems include population response, habitat, and secondary effect. Evidence has recently accumulated that the β-dose component of local fallout may be significantly greater for small organisms than the γ-dose component. Investigations are needed on β-dosimetry in insects representing characteristic body types, and on field response of insects subjected to acute or chronic β-exposures within their natural habitats. Radiation profiles were established for Acheta domesticus and Tenebrio molitor, which possess quite different early life-history stages (morphologically and physiologically, and in their ecological requirements). The 1st experiments involved exposure to γ-radiation from 1 kR to 100% increments. Younger stages again proved more sensitive than older ones. If mean survival times at 4 kR or 8 kR are compared with those of controls, the small larvae (Tenebrio) and small nymphs (Acheta) appear to be considerably more sensitive than older stages. Some general index of radiosensitivity is clearly required. Greater mortality appears to occur in irradiated Acheta in the field than in the laboratory (presumably due to predators and possible pathogens). - Individual lots of bees were tested for sensitivity to β-, γ- and neutron irradiation under laboratory conditions. 5000 rad of γ-radiation reduces the life span of worker bees by 29%. Irradiation of entire social units (colony) (5000 rad γ-rays at 65 rad/min) had catastrophic effects, causing pollination to drop

by 50% in 9 d, and to cease completely by 16 d. Within 8 d post-irradiation, ~99% of the bees had died.

1335 Baccetti, B. A CYTOLOGICAL STUDY OF THE EFFECTS OF RADIATION ON THE DEVELOPMENT OF THE REPRODUCTIVE ORGANS OF TWO SPECIES OF FRUIT FLIES: Dacus oleae AND Ceratitis capitata. Report No.7 (Final), December 20, 1962 - December 19, 1965. NP-16176, Siena Univ. (Italy). Istituto di Zoologia e Biologia. IAEA-169-R2-RB, International Atomic Energy Agency, Vienna (Austria). 10p.

Progress is reported on a cytological study of the effects of 5000 to 8000 R γ- or x-radiation on the development of male and female reproductive organs of two species of fruit flies, D. oleae and C. capitata. Observations made on normal Drosophila melanogaster males are also reported. Applications of the findings in insect control using the sterile-male technique are discussed. Results showed that radiation damages spermatogones and first spermatocytes, but not spermatids. The action of radiation on male gonads appeared to be essentially mutagenic and not to involve structures that influence sperm mobility and penetration. The timing of spermatogenesis at different stages of development from larva to adult was studied in D. oleae by determining the type of germ cells present at each stage. Irradiation carried out during the pupal stage caused a decrease in the number of spermatozoa that reached maturity. It was concluded that the optimal time for males to be irradiated for population control is when meiotic or spermatidic sperm stages are most abundant in the gonad. Observations of radiation effects on female reproductive organs indicated that damage to ovarian structures irradiated at various doses at the pupal stage was qualitatively similar but variable in intensity. Radiation doses that caused an optimal mutagenic effect in males inhibited completely oviposition in females because of damage to the oögonia. (NSA 20: 1986, 42847)

1336 Baroughi-Bonab, H. 1re THESE. ETUDE DU DEVELOPPEMENT POST-EMBRYONNAIRE DE L'OVAIRE CHEZ Ephestia kühniella Z. (LEPIDOPTERA, PYRALIDAE). EFFETS DES RADIATIONS IONISANTES. Thesis, Paris Univ. (France). Faculté des Sciences. 1965, 65p.

The successive developmental stages of the ovary and oogenesis were investigated in the larva, pupa and adult of E. kühniella, and effects of various doses of γ-radiation administered to last-instar larvae was studied. The histological differentiation of ovaries and testes begins to become distinguishable in 4th-and 5th-instar larvae. In the last instar, the ovarioles are clearly distinguishable, and this ovarian "germarium" is described in detail. Each ovariole contains from 40-80 oocytes in different stages of development, corresponding to seven ovarial zones, A-G, which are described. Exposure of last-instar larvae to various doses of γ-radiation caused delays in metamorphosis: instead of the 7 d in controls it extended to 9 d after 2000 rad, 10 d after 4000 rad, 11 d after 6000 rad, 15 d after 8000 rad, 19 d after 10 000 rad, 22 d after 12 000 rad, and 31 d after 14 000 rad. Apart from that, a certain number of larvae die without undergoing metamorphosis which corresponds, on the other hand, to very long larval survival: from 23 d after 6000 rad up to 94 d after 15 000 rad. Larval mortality may reach 25% at 6000 rad, rising to 72% at 14 000 rad and to 100% at 15 000 rad. - The duration of pupation is affected less: from a duration of 8.29 d in controls it changes to 10.33 d in pupae (from larvae irradiated at 14 000 rad). Pupal mortality occurs above 8000 rad (50%), and rises to only 57% at 14 000 rad. It is independent of the delay in pupation. - Radiation effects on ovarian development and oogenesis show up after 2000 rad, administered to last-instar larvae. Subsequent adults are of reduced size but their ovarioles still have the usual oogenic stages in the vitellarium. Only 2/3 of each ovariole is, however, occupied by chorionated eggs of stages G and H, with G predominating. Adult ovaries are reduced still further by 4000 rad. Young oocytes are now rare or have disappeared, and the apical part of the ovariole appears "amputated". At 8000 rad, the moth is literally castrated. The ovarioles measure only 500 μ, dropping to 200 μ at 14 000 rad. The most sensitive oocytes are those at a stage of multiplication in the germarium. - Irradiation of pupae causes less significant changes. The fertility of incompletely sterilized females has not been checked. Already at 2000-4000 rad, however, cytoplasmic anomalies become noticeable, particularly a negative Feulgen reaction.

1337 Bluzat, M.R. MISE EN EVIDENCE DE LA RADIORESISTANCE DU DETERMINANT GERMINAL CHEZ Leptinotarsa decemlineata Say. C. r. hebd. Séanc. Acad. Sci. 265, 25 D (1967) 2027-2029.

The posterior extremities of eggs of the insects were exposed to x-radiation before attaining the stage of 16 nuclei. Histological sections of larvae from irradiated eggs were prepared for examination of

the gonads. A 2nd group of irradiated eggs was reared to adults and the gonads were examined. Adults developing from eggs exposed to a dose of 10^6 R were fertile and reproduced normally: this demonstrates the extreme radioresistance of the germ cells. Larvae developing from eggs exposed to 10^7 R contained gonads without gametes. This result was not caused by selective destruction of the germinal primordia located in the posterior region of the egg. (NSA 22: 1968, 19433)

1338 Boguleanu, G. OBSERVAŢII ASUPRA COMPORTĂRII CRISALIDELOR DE Hyphantria cunea Drury IRADIATE CU RADIAŢII GAMMA. (Observations on the behaviour of pupae of Hyphantria cunea Drury irradiated with γ-radiation.) Studii Cerc. Biol., Ser. Zool. 17 (1965) 387-391. (In Rumanian)

The following is based largely on the author's summary. In experiments in Rumania, the susceptibility of pupae of H. cunea (Dru.) to γ-radiation varied greatly with age. Adults from pupae treated when 5-8 d old with 30 000 rem were almost normal in rate of emergence, life-span and mating ability, whereas those from pupae irradiated when 1-3 d old were adversely affected. Doses of 10 000-60 000 rem administered to pupae 3 d old greatly reduced adult emergence, adult life-span and oviposition and caused complete sterility of any eggs laid. The same doses applied to pupae 6 d old permitted almost normal adult behaviour: with doses of 40 000-60 000 rem, the eggs that were laid failed to hatch, and with 10 000-30 000 rem the eggs hatched but the larvae soon died. (RAE-A 55: 1967, ref. 26)

1339 Burkholder, W.E., Tilton, E.W., Cogburn, R.R. EFFECTS OF GAMMA RADIATION ON THE GRAIN MITE, Acarus siro. J. econ. Ent. 59, 4 (1966) 976-980.

The egg, larval, hypopial, and adult stages of the mite were treated with 13.2 (±10%), 17.5, 25, 45, and 100 krad of γ-radiation. Eggs hatched at 100 krad. Eggs and hypopi were able to transform to the adult stage at 45 krad, but larvae did not mature at dosages >25 krad. Irradiated adults produced F_2 adults after dosages as high as 25 krad and irradiated hypopi and eggs at ≤17.5 krad, but larvae did not produce F_2 adults at dosages > 13.2±10% krad. (From auth.)

1340 Cavalloro, R., Cirio, U. RICERCHE CON RADIAZIONI IONIZZANTI SULLA STERLIZZAZIONE E RADIOSENSIBILITA DI Chrysomela decemlineata Say. (Study on the sterilization and radiosensitivity of Chrysomela decemlineata Say be means of radioisotopes.) Redia 50 (1966/1967) 365-377. (In Italian, with English summary)

The possible application of the sterile male technique to this pest of the Solanaceae family, particularly of the potato plant, was explored. Optimal conditions of day and night temperature, relative humidity, photo-period, light intensity and diet, were first determined in order to produce large numbers of insects in a controlled environment chamber. Irradiation with 200 kV x-rays showed that radioresistance increased with the development: doses resulting in 30% lethality thus increased in the ratio 1 to 60 to 240 of 1-d-old eggs, 1-week-old pupae, and 3-d-old adults, respectively. Radiation resulted in increased mortality of offspring, especially during moulting, and a lengthening of the various larval instars as well as a reduction of the life-span in adults irradiated as adults or emerging from irradiated pupae. The min. exposure dose for sterilization of both sexes proved to be 3000 R for pupae irradiated 3 d before the end of metamorphosis, and did not affect the sexual vigour of the insect. The sterile male technique could therefore be used in controlling this pest. (Based on auth.)

1341 Chettachai Baditsing. A STUDY ON THE LIFE HISTORY AND THE EFFECT OF RADIATION ON RICE WEEVIL (Sitophilus oryzae L.). p. 42-47 of "Insect Eradication by Irradiation, Bangkok, Thailand, 28-29 Jun. 1966". THAI. AEC-8, Office of Atomic Energy for Peace, Bangkok (Thailand).

The egg, larval, and pupal stages were found to last for 7-9, 13-17, and 7-11 d, respectively. The highest rate of oviposition was at 3-7 d. Different stages were exposed to radiation (from a ^{60}Co-source and the reactor, ^{235}U). Males were more radiosensitive. Sterility in adults was induced by 3500-4000 rad, no hatchability being observed at 4000 rad. The LD 50 for egg, larval, pupal, and adult stages were 15, 120, 1300, and 74 000 rad, respectively. In the laboratory, a dose of 25 000 rad killed 100% at the egg and the larval stage and 91.90% at the pupal stage, whilst all adults died within ~10 d of exposure.

1342 Cogburn, R.R., Tilton, E.W., Burkholder, W.E. GROSS EFFECTS OF GAMMA RADIATION ON THE INDIAN-MEAL MOTH AND THE ANGOUMOIS GRAIN MOTH. J. econ. Ent. 59 (1966) 682-685.

A study of the gross effects of γ-radiation on the Indian-meal moth, Plodia interpunctella (Hübner), and the Angoumois grain moth, Sitotroga cerealella (Olivier), was conducted. All metamorphic stages of the insects were treated with 13.2±10%, 17.5, 25, 45, or 100 krad of γ-radiation. Weekly observations were made to check mortality, ability of treated metamorphic stages to continue their development, and reproduction by treated individuals and their first-generation progeny. Eggs of both species and larvae of the Indian-meal moth were effectively controlled by all dosages. Larvae of the Angoumois grain moth were controlled by all dosages except 13.2±10% krad, which permitted some larvae to develop to the adult stage and reproduce. The life of insects treated as adults or as pupae was not greatly shortened by the treatments, but the incidence of sterility and a marked reduction in progeny produced per pair of moths varied directly with the dosage applied. Genetic damage, as evidenced by reduced reproduction, was transmitted to the F_1 generation. When treated directly, males of both species were less subject to genetic damage than were females; however, the progeny of treated males was more subject to genetic damage than was the progeny of treated females. A dosage of 17.5 krad should be sufficient to eliminate hidden infestations of eggs and young larvae of both species in packaging plants by preventing further development. (Essentially auth.)

1343 Craig, G.B., Jr. APPLICATIONS OF GENETIC TECHNOLOGY TO MOSQUITO REARING. Bull. Wld Hlth Org. 31 (1964) 469-473.

Experiments demonstrated useful levels of heterosis in Aedes aegypti. Characters improved by heterosis included resistance of eggs to radiation. The heterotic improvement was also evident in crosses between random-breeding strains. Crosses between the Rock and Red Eye strains of mosquitoes were made in connection with experiments on the effect of radiation on egg development. Considering the time required to complete pupation, the Rock parent required 28% and the Red Eye required 71% more time than did their F_1 progeny. It was noted that the hybrids were more resistant to radiation than the parental stocks. From eggs receiving a dose of 100 R of x-rays, no Red Eye pupated but 23% of Rock did pupate. However, 65% of the F_1 pupated. This radioresistance was probably due to heterosis rather than to a specific protective mechanism. From preliminary evidence, it appeared that the rate of mitosis in the hybrids was higher and therefore repair of radiation damage was more readily effected. (NSA 22: 1968, 2545)

1344 DeProost, M. BELGIUM CONTRIBUTIONS TO THE DATA ON IRRADIATION OF SUBSTANCES. CONF-650581-1, Centre d'Etude de l'Energie Nucléaire, Mol (Belgium), nd, 6p. "2nd International Symposium on Applications of Nuclear Science in Agronomy and Veterinary Medicine, Ghent, Belgium".

A brief review of the research projects in Belgium concerned, amongst others, with food irradiation and the effects of γ-radiation on metamorphic stages of the grain and rice weevils, Sitophilus granarius L. and S. oryzae L., the Mediterranean flour moth, Anagasta kuehniella, and the white bean infesting beetle, Acanthoscelides obtectus. Studies on the genetic risks involved in consumption of γ-irradiated foods are also briefly outlined. Descriptions of the ^{60}Co γ-irradiation facilities that were used in the projects are given.

1345 Ducoff, H.S., Bosma, G.C. INFLUENCE OF PUPAL AGE ON SENSITIVITY TO RADIATION. Biol. Bull. 130 (1966) 151-156.

Tribolium confusum exposed to germicidal u.v. at any time during the 5-d pupal period exhibits a high incidence of gross morphological deformities, particularly of the wings, in the emerging adult, although the greatest sensitivity to this effect occurs on the 1st day of pupation. Mortality within two weeks is by far the greatest, however, if u.v. irradiation is performed on the 3rd day of pupation. By contrast, sensitivity to both lethality and abnormality-induction after x-ray exposure is greatest on the 1st day of pupation and declines progressively thereafter, with the sharpest decline occurring late on the 2nd day. These differences are partially explained by the fact that energy absorbed from x-rays is distributed rather uniformly throughout the pupa, whereas most of the u.v. energy is absorbed in the outermost tissue layers. (Auth.)

1346 Ducoff, H.S. CHANGES WITH AGE IN THE RADIOSENSITIVITY OF ADULT FLOUR BEETLES. Radiat. Res. 31, 3 (1967) 612. Abstr. Eb-2. Presented at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

Adults of the flour beetle, Tribolium confusum, exhibited a marked and progressive increase of radiosensitivity with age. Although there is no detectable difference in radiosensitivity between males and females in newly emerged beetles, the sensitivity of males increases with age more rapidly than that of females. Thus, for example, the LD 50/5 weeks at 30° is 12 kR for young adults of either sex, is 11 kR for 4-month-old females, and is just under 10 kR for 4-month-old males. Nine months after eclosion, the LD 50 (uncorrected for control mortality) is about 7 kR for females and 6 kR for males. The estimates for 9-month-old adults have a large error because of the small numbers and significant control mortality, but the sex-difference is all the more spectacular because the mortality rate of control females is greater than that of males. Beetles raised and maintained at 22° rather than 30°C also exhibit a progressive increase in radiosensitivity, but the change develops more slowly, as would be expected of a phenomenon dependent on metabolic processes. These results should be considered in the light of findings by previous investigators, and confirmed in our own studies, that beetles surviving low or midlethal radiation doses exhibit increased mean lifespan. (Abstr.)

1347 El-Miniawi, S.F., Leheta, M.F. ON THE EFFECT OF Co^{60} GAMMA RADIATION ON THE DESERT LOCUST. Bull. Soc. ent. Égypte 48 (1964) 5-10.

1st, 3rd and 5th-instar hoppers and adults of Schistocerca gregaria Forsk. were exposed to doses ranging from 200 R - 30 000 R, at dose rates of 200 R/min and 680 R/min. Mortality data were obtained 3 and 5 d, and 1 and 2 weeks after exposure. Susceptibility decreases with increasing age, but increases with the dose received. Doses > 1000 R stopped feeding and produced sluggishness. Cannibalism among 5th-instar hoppers was frequent even after small doses. Females were less susceptible to radiation than males. A dose of 30 000 R produced LD 98.5/5d (high rate) and /7d (low rate) in 3rd-instar hoppers, with a corresponding LD 100 for 5th-instar hoppers.

1348 Erdman, H.E. METAMORPHIC AND ADULT LONGEVITY MODIFICATIONS DUE TO x-IRRADIATION OF PUPAL FLOUR BEETLES, Tribolium confusum (Jacquelin du Val). Bull. ent. Soc. Am. 12 (1966) 256. Abstr. 3. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov.- 1 Dec. 1966".

Undelayed metamorphosis and reduced numbers of adults having decreased longevity were noted up to 70 kR x-radiation of pupae regardless of sex. Explanations of these radiation effects concern differential radiosensitivities of dividing and non-dividing cells, frequency and occurrence of cell divisions in specific tissues, and nuclear vs. cytoplasmic alterations. (Abstr.)

1349 Erdman, H.E. EFFECTS OF x-RAYS ON METAMORPHOSIS AND ADULT LIFE SPAN OF FLOUR BEETLES. Nature, Lond. 211 (1966) 1427-1428.

The investigation was undertaken to determine whether metamorphosis and length of life could be altered when flour beetle pupae were treated with x-rays. 25-26 d old pupae of Tribolium confusum duVal were sexed and given doses of 0, 1, 2.5, 5, 7.5, 10, 20, 30, 40, 50, 60, and 70 kR of x-rays. Each of 5 replicates at each dose contained 10 pupae of each sex. Deaths were noted twice weekly (culture at 29±1°C, r.h. 60-75%). The number of individuals unable to complete metamorphosis increased progressively from 5-70 kR, without delays in metamorphosis, against a 35% failure to metamorphose at 7.5-50 kR, and ~55% at 70 kR. Mortality increased progressively with increasing exposures. At 7.5 kR lethality approached 100% after 9 d, possibly due to adverse effects of radiation cell division(s). The lethality curve for 2.5 kR rose gradually, reaching a plateau by day 9 at 10-15%. The 5 kR curve had a gradual slope which levelled off by day 16 at ~60% lethality. Pupae (26-d-old) and 1-d-old adults were sterilized by 4 kR, indicating no change in meiotic activity between these developmental stages.

1350 Erdman, H.E. ONTOGENY AND x-RADIATION SENSITIVITY OF THE FLOUR BEETLE, Tribolium. p. 16-17 of "Pacific Northwest Laboratory Annual Report for 1966 to the USAEC Division of Biology and Medicine. Vol.1. Biological Sciences". BNWL-480, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Jul. 1967, 207p.

Early egg stages were most sensitive to irradiation. Mature larvae of T. castaneum were more sensitive than younger larvae or more advanced stages. Lethal doses for adults of two strains of this species were 14-15 kR and sterilizing doses were 5 kR. T. confusum was more sensitive with adult lethality at 8 kR and sterility at 4-5 kR.

1351 Erdman, H.E. EFFECTS ON FLOUR BEETLES IRRADIATED AS PUPAE. p. 17-18 of "Pacific Northwest Laboratory Annual Report for 1966 to the USAEC Division of Biology and Medicine. Vol.1. Biological Sciences". BNWL-480, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Jul. 1967, 207p.

Incomplete metamorphosis and reduced adult life span were observed when pupae of the flour beetle Tribolium confusum were x-irradiated.

1352 Farkas, J. THE RADIATION RESISTANCE OF Tribolium confusum (Duval) AND Tyrophagus dimidiatus (Hermann). Közl. Kozponti Elelmiszeripari Kutatointenzet 2 (1965) 10-15. (In Hungarian)

1353 Farkas, I. STUDY OF THE IRRADIATION TOLERANCE OF Tribolium confusum (Duval) AND Tyrophagus dimidiatus (Hermann). Acta biol. Hung. 16 (1967) (p?)

1354 Féron, M. STERILISATION DE LA MOUCHE MEDITERRANEENNE DES FRUITS, Ceratitis capitata Wied., PAR IRRADIATION DES PUPES AUX RAYONS GAMMA. Annls Épiphyt. 17, 2 (1966) 229-239.

Experiments on the sterilisation of C. capitata (Wied.) by treating the pupae with γ-radiation were carried out in France. Pupae irradiated at 5-15 kR when 2-6 d old were killed or gave rise to adults that died soon after emergence; irradiation of older pupae did not affect emergence, but a dose of 15 kR caused rapid mortality. Female fecundity was reduced by treatment with 3 kR and decreased with increase of the dose; irradiation did not, however, prevent the females from making many oviposition punctures in the fruits provided and laying some non-viable eggs. Male pupae irradiated at 8 kR gave rise to sterile adults with unimpaired mating capacity. Studies with mixed populations of normal and treated adults showed that a ratio of at least 30 sterile flies to one normal one was necessary in order to obtain a reduction of over 90% in egg viability. (RAE A 55: 1967, ref. 613)

1355 Flint, H.M., Kressin, E.L. GAMMA IRRADIATION OF PUPAE OF THE TOBACCO BUDWORM. J. econ. Ent. 60, 6 (1967) 1655-1659.

Pupae of the tobacco budworm, Heliothis virescens (F.), were irradiated with ^{60}Co γ-rays before adult emergence. Male moths were 99% sterile after a dose of 35 krad. Female moths produced very few eggs when the dose was greater than 35 krad, though there was some egg hatch at this dose level. The emergence and lifespan of both sexes were reduced by sterilizing doses. The initiation and length of the oviposition periods for females mated with either treated males or untreated males were similar. However, females crossed with treated males produced significantly fewer eggs. Virgin females laid eggs, but their oviposition began later and was shorter than that of females crossed with males. The average life-time production of eggs for single pairs of control moths was about 800 eggs, though some females did produce more than 1600. When the sterility data from irradiated males were plotted, the resulting dose-response curve appeared to be sigmoidal. Cytological observations on spermatogenesis indicated that sperm were present in the testes of the pupae at the time of irradiation. (Auth.)

1356 Gubicza, A., Molnar, I. THE EFFECT OF GAMMA IRRADIATION ON THE VARO RACE OF Bombyx mori L. II. IRRADIATION OF EGGS IN THE EARLY AND LATE EMBRYONIC STAGES. Annls Inst. biol. Tihany 31 (1964) 3-13.

Results are summarized from a study of the effects of γ-radiation on the eggs of the silkworm, B. mori, exposed during various developmental stages, and on the morphology of larvae and on the health and fecundity of adult moths hatched from irradiated eggs. (NSA 20: 1966, 18345)

1357 Harshbarger, H.C., Moore, B.S. SOME EFFECTS OF x-IRRADIATION ON LARVAE OF Galleria mellonella. J. invertebrate Path. 8, 2 (1966) 277-279.

2nd-and 3rd-instar larvae of G. mellonella (L.) irradiated with x-rays at 12 000 R at the rate of 500 R/min showed numerous cellular abnormalities in the last instar, some of which are described. The larval period was increased by two months, and pupation was partially or completely inhibited. (RAE-A 55: 1967, 81)

1358 Henneberry, T.J. SUSCEPTIBILITY OF VARIOUS STAGES OF Drosophila melanogaster TO GAMMA RADIATION. J. econ. Ent. 60, 4 (1967) 1041-1043.

All stages of D. melanogaster Meig. were exposed to γ-radiation from a ^{60}Co source. The sensitivity, in descending order, was: eggs, 1-d-old larvae, 1-d-old pupae, 3-d-old larvae, 3-d-old pupae, and adults. Exposure of eggs to ≥ 0.9 kR caused a high mortality rate in the egg and larval stages after exposure to 0.4 or 0.6 kR; death occurred in the pupal stage. Irradiation of larvae resulted in a high rate of pupal mortality. Adult females exposed to as much as 35 kR lived as long as untreated females. Adult males were shorter lived than untreated males after exposure to 21 kR or more. (Auth.)

1359 Kahan, R.S., Peleg, B.A., Eisenberg, E. RADIATION SUSCEPTIBILITY OF VARIOUS DEVELOPMENTAL STAGES OF THE MEDITERRANEAN FRUIT FLY (Ceratitis capitata Wied.) p. 282-283 of "Research Laboratories Annual Report. For the Period January-December 1965". IA-1082, Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center. 363p.

An experiment is being carried out to determine the lethal dose of γ-radiation for laboratory-bred flies at various stages of the development cycle. The insects are dispersed in a suitable synthetic food medium and irradiated with the ^{60}Co plate source. This dose also rendered the adult fly sterile. Thus 10 krad may be sufficient for quarantine control of citrus and other fruits against this fly. Tests are now being carried out with lower doses and in vivo conditions, and eventually the wild type flies will be studied. (Abstr.)

1360 Kakhmanyuk, F.S., Petryna, M.F. EFFECT OF x AND γ RADIATION ON THE DEVELOPMENT OF UNMATCHED GYPSY MOTHS (Ocneria dispar L., LYMANTRIDAE, LEPIDOPTERA). Vestsi Akad. Navuk BSSR, Ser. Biol. No.2 (1967) 98-104. (In Byelorussian)

The irradiation of caterpillars of unmatched gypsy moths with x- and γ-radiation at doses up to 500 R causes both a stimulating effect on the growth and development of the caterpillars as well as sterility (partial) of the developing males and females. The moths developing from irradiated caterpillars were quickly mated and as a result dark-coloured individuals appeared more often. Irradiation at doses of 500-5000 R did not cause externally any more deviations from the control caterpillars, but the sterilising effect appeared sooner. The irradiation of caterpillars at doses above 5000 R had a depressing effect on the growth and development and caused a significant increase of the sterilised individuals. A larger number of light-coloured individuals characterized by a low stability with respect to disease and changes in the abiotic factors occurs. x-radiation has a more depressing effect than γ-rays at all doses. (tr-auth.)

1361 Khan, Z.A., Matin, A.S.M.A. THE SUSCEPTIBILITY OF THE DIFFERENT STAGES OF RICE WEEVIL, Sitophilus oryzae L. TO GAMMA RADIATION. AECD/AG/22, Atomic Energy Centre, Dacca (Pakistan). May 1967, 15p.

A study was conducted on the effects of γ-radiation from a ^{60}Co-source on all developmental stages of rice weevil, S. oryzae L. Complete mortality of eggs was obtained by 2500 R, of larvae by 8000 R, of pupae by 10 000 R, and of adults by 12 000 R. Production of progeny was stopped at 9000 R in all the developmental stages. 12 000 R might be considered as minimum effective dose for the control of S. oryzae L. (Auth.)

1362 Kuzin, A.M., Yusifov, N.I. RADIOSENSITIVITY AT DIFFERENT DEVELOPMENTAL STAGES OF Ephestia kuehniella L. IN THE LIGHT OF EXPERIMENTS ON THE TRANSINDUCTION OF DNA. Radiobiologiya 7, 1 (1967) 3-6. (In Russian)

Different developmental stages were irradiated with γ-rays from a ^{137}Cs source, at 700 R/min. The results are interpreted in terms of interference with the transmission of information, referred to as DNA transinduction. 1-d and 4-d-old eggs, larvae 3-5 h after hatching from 28- and 34-d-old eggs, and pupae 1, 2, 4 and 9 d after pupating were used. The radiation effect was estimated in terms of the number of insects able to pass into the next developmental stage. The dose range studied was from 1-50 kR. After irradiation, the insects were kept in a thermostat at 30 °C and 50-60% r.h. The results represent average values from 3 series of experiments. The dose-effect curves were obtained for different radiation effects. The results indicate an extremely high radiosensitivity of the DNA transinduction process, in connection with the transmission of new information and transition from one developmental stage to another. Thus, larvae continued to grow after irradiation but when it was time for a new piece of information to be transmitted to bring about

pupation, DNA transinduction appeared to be totally suppressed, so that a larva continued as such for some 10 d without turning into a pupa.

1363 Lassota, Z. THE DELAYED DEATH OF 20 kR GAMMA RAYS IRRADIATED EMBRYO OF Bombyx mori. p. 137 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun.-2 Jul. 1966, 263p." Abstr. 543.

Irradiation of diapausing eggs of B. mori with 20 kR of ^{60}Co γ-rays inhibits completely the hatching; the post-diapausal development however, albeit delayed, is not immediately arrested. The respiration is blocked at the level characteristic for normal gastrula (300 µl 0_2 uptake/h/g of eggs). The synthesis of DNA continues till the amount of 1.2 mg/g of eggs is attained, corresponding to that found in normal eggs just ready to hatch. The synthesis of RNA is injured, the total amount being by 20% lower than in normally gastrulating eggs (4.5 mg and 5.5 mg per 1 g of irradiated and normal eggs respectively). The neurulation is abnormal as indicated by the low acetylcholine content found at the end of post-diapausal incubation (35 µg and 80 µg/1 g of irradiated and normal eggs, respectively). The effects of investigated radiation dose are in many respects similar to those observed by Brachet et al. (Devl Biol 9: 1964, 398) in actinomycin D treated amphibian embryo. The damage of transcription process is suggested as the main mechanism of delayed injury of insect embryogenesis, due to ionizing radiation. (Abstr.)

1364 Lecis, A. EFFECTS OF x-RAYS ON THE LARVA AT THE FOURTH STAGE OF Anopheles maculipennis atroparvus. Atti Ass. genet. ital. 8 (1963) 236-241. (In Italian, with English summary) "Proceedings of the 8th Scientific Meeting of the Italian Genetic Association, Torino, Italy, 1-3 Oct. 1962".

Larvae of the species A. m. atroparvus in the four stages were irradiated, part of them 24 h after moulting and part 96 h after moulting. The adult hatched from these larvae were mated with normal ones. Mortality was higher in the larvae irradiated 24 h after moulting than in those irradiated 96 h after moulting. This difference is probably due to mitotic disturbances which take place more frequently in the stages of growth of the larvae mutated after only 24 h than in those mutated after 96 h, near to the nymphosis. From the crossing of adults hatched from irradiated larvae with normal females, with control of ovodeposition it was observed that percentage of hatched eggs and eggs having dead embryos was considerably different in the two types of experiment. As the number of hatched eggs was decisively higher, and the number of dead embryos lower in the larvae irradiated 24 h after moulting, it follows that a lower frequency of dominant lethal mutations must exist in the larvae irradiated 96 h after moulting. This would seem to signify that the greatest sensibility to x-ray effects is when the spermatogenetic phenomena are completely or almost over. In the larvae mutated after 24 h only spermatogonial cells in the mitotic or intercinetic stages were observed, there were some leptotenic stages and rare cases of pachitenic; on the contrary in those mutated after 96 h there were abundant spermatids and prespermatid stages. (Auth.)

1365 Lippold, P.C., Gambrell, F.L. COBALT-60 RADIATION STUDIES WITH THE EUROPEAN CHAFER. Bull. ent. Soc. Am. 12 (1966) 286. Abstr. 97. Presented at "Portland Meeting, Portland, Oreg., USA. 28 Nov.- 1 Dec. 1966".

Dosages of 3000 rad on 3rd-instar larvae inhibited adult development. An LD 50 of 110 000 rad was obtained for adults 5 d after treatment. Crosses with 3500 rad-treated field-collected females resulted in infertile eggs. Mature check eggs were killed at 150 000 rad. (Abstr.)

1366 McClanahan, R.J., Simmons, H.S. STERILIZATION OF ONION MAGGOTS BY IRRADIATION WITH CESIUM-137. Can. Ent. 98, 9 (1966) 931-935.

Pupae of the onion maggot, Hylemya antiqua (Meigen), did not complete their development when irradiated with 3.0 kR within 5 d of pupal formation. Older pupae were not adversely affected. Females from treated pupae were sterile and laid no eggs when caged with normal males. The males from treated pupae were sterilized to a high degree, yet normal females mated with them and laid normal complements of eggs. Less than 0.2% of 10 616 eggs laid by normal females caged with sterile males hatched. A 8:1 ratio of sterile to normal flies reduced egg hatch to 1.7%. (Auth.)

1367 Mueller, I., Pentz, S., Harte, C. DEPENDENCE OF THE SOMATIC MUTATION SPECTRUM OF Ephestia kuehniella ON THE DEVELOPMENT STAGE OF THE IRRADIATED ANIMAL. Z. VererbLehre 97 (1966) 353-360. (In German)

Experiments were conducted to determine whether the developmental stage at irradiation affected the sensitivity pattern for mutant types in Ephestia. Dose effect curves were established for pupae of two age groups corresponding to the stages that were attained by preirradiation treatments at low and high temperatures. Moth pupae were exposed to 100, 200, 400, 600, 800, or 1000 R doses of x-rays. The exponent of the dose effect curves was the same for all mutant types and independent of the age at irradiation. Age groups differed in their mutational spectra. Results are discussed with regard to a possible difference in the specific radiosensitivity of epithelial cells and scale stem cells. (NSA 20: 1966, 42970)

1368 Murakami, A., Tazima, Y. STUDIES ON STRAIN DIFFERENCES IN RADIOSENSITIVITY IN THE SILKWORM. I. SCREENING OF SENSITIVE AND RESISTANT STRAINS TO EMBRYONIC RADIATION KILLING. Rep. natn. Inst. Genet., Misima No.17 (1966) 98-100.

1369 Murakami, A., Tazima, Y. STUDIES ON STRAIN DIFFERENCES IN RADIOSENSITIVITY IN THE SILKWORM. II. RELATION BETWEEN SENSITIVITY TO EMBRYONIC KILLING AND MUTABILITY. Rep. natn. Inst. Genet., Misima No.17 (1966) 100-101.

1370 Murakami, A. VARIATION IN RADIOSENSITIVITY DURING THE EARLY DEVELOPMENTAL STAGE OF THE SILKWORM EGG. Rep. natn. Inst. Genet., Japan 16 (1966) 107-109.

In order to elucidate differences in radiosensitivity at various phases of the DNA cycle of the cell, newly deposited eggs were used, taking hatchability as a criterion. Wild type C108 female silkworm were mated with males with the double recessive egg colour genes, pe and re. Three series of experiments were carried out, using either γ- or x-rays (I - eggs collected at 30 min intervals, subjected to 1000 R γ-rays at 100 R/min; II - collected at 15 min intervals, subjected to 1000 R 173 kVp x-rays, at 1000 R/min; III - collected at 10 min intervals, subjected to 1000 R x-rays). Cytological observations by the squash method showed that the time required for one division cycle was 45-50 min at 25°C, and 30 min at 30-31°C. The results were in good agreement with those obtained from hatchability data, indicating that the radiosensitivity pattern may well be correlated with a cyclic change in the cell division cycle. The cytological studies now in progress indicate that the peak of radiosensitivity appears around late prophase and metaphase.

1371 Murphy, C.G. DETERMINATION OF THE DORSAL MESOTHORACIC DISC IN Drosophila. Diss. Abstr. 27, 8 (1967) 2923-B.

The right and left dorsal mesothoracic imaginal discs of Drosophila larvae each give rise to one wing and one-half of the thoracic mesonotum with its characteristic pattern of bristles. Experiments involving extirpation and transplantation of whole discs, as well as cell lineage studies of genetically marked tissue indicated that the right and left dorsal mesothoracic discs were determined as separate anlagen early in development, probably in the embryonic stage. On the other hand, particular regions within each disc were later found to be individually capable of regulative reorganization under special conditions, such as x-ray treatment or provision of an extra period of growth before metamorphosis and concomitant differentiation. Thus, the discs were shown to be capable of intrinsic regulation, but free from regulative influences emanating from other anlagen. Similar results were obtained with the two eye discs, each of which normally gives rise to one eye and one-half of the dorsal surface of the head with its associated structures. The evidence presented indicates that these disc pairs, although participating in the formation of medium structures, do not exist as members of a bicentric regulative field. Instead it is concluded that determination of both eye and wing disc pairs into right and left entities is complete, both in mature larvae and in larvae in the middle of the third instar. (From DA)

1372 Nair, K.K., Bhaskaran, G., Sivasubramanian, P. EFFECT ON ADULT EMERGENCE OF WHOLE AND PARTIAL x-IRRADIATION OF PUPAE OF THE HOUSEFLY, Musca domestica nebulo. Can. Ent. 99, 6 (1967) 597-598.

Irradiation of specific regions of 5- to 20-h-old housefly pupae with x-rays shows that exposure of anterior seven segments alone to 1200 R prevents adult emergence, whereas irradiation of posterior

region with doses up to 10 000 R has no effect on this phenomenon. It is evident that the target organ, damage to which results in the failure of adult emergence, lies in the anterior seven segments. It is suggested that failure to emerge is due to a direct effect of radiation on the differentiating myoblasts leading to dystrophy of the muscles. (Auth.)

1373 Nelson, T.E. THE EFFECTS OF GAMMA RADIATION UPON VARIOUS STAGES OF Fannia canicularis (L.). Bull. ent. Soc. Am. 12 (1966) 278. Abstr. 253. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

The lethal and sterilizing dosages of γ-radiation were determined for various developmental stages of the little housefly, Fannia canicularis (L.). The flies were exposed to γ-radiation in a 300 Ci ^{60}Co-irradiator with a mid-point flux of ~200 rad/min. (Abstr.)

1374 Planel, H., Soleilhavoup, J.P., Giess, M.C., Tixador, R. MISE EN EVIDENCE D'UN RETARD DE DEVELOPPEMENT DE Drosophila melanogaster PAR DIMINUTION DE LA RADIOACTIVITE NATURELLE AMBIANTE. C. r. hebd. Séanc. Acad. Sci. D 264, 6 (1967) 865-868.

Les méthodes de culture et de radioprotection ont été identiques à celles décrites précédemment. Les résultats démontrent que les diminutions de population des élevages effectués sous radioprotection ne sont pas provoquées par l'arrêt de développement de certains organismes embryonnaires ou larvaires, mais par un simple allongement du développement des pontes. Cette conclusion est démontrée d'une part par le retard des éclosions observé dans les cultures protégées, et d'autre part par l'identité numérique des populations adultes constatée après la fin des éclosions, du 14^{e} au 17^{e} jour.

1375 Planel, H., Soleilhavoup, J.P., Giess, M.C., Tixador, R. RECHERCHES SUR L'ACTION DES RADIATIONS IONISANTES NATURELLES CHEZ Drosophila melanogaster. (Studies on the action of ionizing radiations on Drosophila melanogaster.) C. r. Séanc. Soc. Biol. 161, 2 (1967) 467-470.

Previous studies have shown that natural ionizing radiations have a beneficial effect on unicellular animals by accelerating multiplication. Tests were made on Drosophila to determine if a similar effect could be observed on multicellular animals. The use of a radioprotective chamber caused a delay in the development of laying eggs. (NSA 22: 1968, 17045)

1376 Qureshi, Z.A. EFFECTS OF SUB-LETHAL GAMMA RADIATION ON THE BIOLOGY AND BEHAVIOR OF THE ANGOUMOIS GRAIN MOTH, Sitotroga cerealella Olivier. Diss. Abstr. 26 (1966) 7511-7512.

Data were obtained on hatching of eggs irradiated with 2-18 kR at different ages. A 10 Ci-^{60}Co source was used. Development within kernels was observed by x-ray radiographs. Early and late 1st instar were irradiated at doses of from 2-20 kR; 3rd and last instars, and early and late pupae, from 5-25 kR; prepupae, from 3-24 kR. Fecundity and fertility were determined by mating irradiated females with normal males and vice versa. Effects of irradiation on females were evaluated by number and hatchability of eggs, as compared with normal females. Effects of irradiation on male fertility were appraised by mating males with normal females and noting fecundity and viability of eggs. Upon emergence, following irradiation, moths were weighed within 24 h and the adult life span recorded upon death. Results following irradiation of eggs of different ages showed that sensitivity declines with age. Larvae from eggs irradiated at age 24-48 and at 48-72 h, treated with 10, 14 and 18 kR did not develop; in dosages of 2 and 6 kR and check, larvae developed normally. Adult emergence after irradiation of early and late 1st instar, 3rd instar, and last instar, prepupae and early pupae revealed that irradiation delayed emergence and reduced the number emerged. Earlier stages were more sensitive than older ones. More males than females emerged when early larvae were irradiated, but the ratio was approximately unity with irradiated pupae. Structural deformities included twisted wings, fusion of tarsal segments, fusion of antennal segments, incomplete emergence and tumour formation in the abdominal region. They were largely found on adults irradiated while immature. Emergence of F_1 adults from irradiated 1-d-old adults showed that larvae developed under all radiation treatments but the number of emerged moths was less than in the controls. Fecundity and fertility studies indicate that 20 kR may cause complete sterility of both sexes when irradiated as 1st instar, 3rd instar, last instar and early pupae. Female adults following irradiation of prepupae when mated with normal virgin males and vice versa either failed to oviposit or laid infertile eggs after 10 kR. Generally, irradiated females were more sensitive to radiation than males. None of the doses prevented the hatching of eggs in crosses where treated males were

mated to untreated females and vice versa, following irradiation of late pupae. In crosses where treated females were mated to untreated males, and vice versa female fertility was reduced significantly from controls after doses of ≥ 10 kR. Fecundity and fertility of females in 1-d-old irradiated adults was significantly different from the controls under various crosses, but the crosses where treated males were mated to treated females showed a marked reduction in fecundity and fertility as compared to the crosses where treated males were mated to untreated females or treated females to untreated males. Adult longevity following irradiation of early and late 1st instar, 3rd instar and last instar, prepupae, early and late pupae and 1-d-old adults was not significantly different from the controls. Emerged adults irradiated as early and late 1st instar and last instar showed a significant reduction in body weight. (From DA)

1377 Qureshi, Z. A., Wilbur, D. A. EFFECT OF SUB-LETHAL GAMMA ON EGGS, EARLY, INTERMEDIATE, AND LAST INSTAR LARVAE OF THE ANGOUMOIS GRAIN MOTH, Sitotroga cerealella Oliv. p. 112-124 of "Proceedings of the Agricultural Symposium, Dacca, Pakistan, 13-14 May, 1966", 1966, 166p.

Irradiation of eggs of different ages showed that sensitivity declined as the eggs became older. Hatched larvae from eggs irradiated at age group 24-48 and 48-72 h, treated with dosages of 10, 14, and 18 kR did not develop; in dosages of 2-6 kR the larvae developed normally. The adult emergence pattern after irradiation of the early and late 1st instar or the 3rd and last instar revealed that irradiation delayed emergence and reduced the number emerged. Earlier stages were more sensitive than older ones. Structural deformities included twisted wings, fusion of antennal segments, fusion of tarsal segments, incomplete emergence and tumour formation in the abdominal region. (Auth.)

1378 Deleted.

1379 Raun, E.S., Lewis, L.C., Picken, J.C., Jr., Hotchkiss, D.K. GAMMA IRRADIATION OF EUROPEAN CORN BORER LARVAE. J. econ. Ent. 60, 6 (1967) 1724-1730.

Actively growing non-diapausing 3rd-, 4th-, or 5th-instar laboratory-reared larvae of the European corn borer, Ostrinia nubilalis (Hübner), were irradiated with γ-rays from a ^{60}Co source. Diapausing larvae collected in the field were irradiated after either 3 or 5½ months of refrigeration. The non-diapausing larvae had too much somatic damage from the irradiation to make this a practical method of borer control. However, the diapausing larvae showed little evidence of somatic damage. Rates of pupation, moth emergence, and mating were nearly normal at levels of irradiation as high as 5000 rad. Numbers of eggs laid and egg hatch were most severely affected at 4000 and 5000 rad. There was an interaction between time to pupation and dose level when diapausing larvae were irradiated and then divided into three groups (A, B, and C) based on length of time to pupation. Egg hatch was significantly affected. All levels of radiation affected pupation period A (early) most strongly. Only 4000 and 5000 rad affected hatchability of eggs from pupation period B (middle). Only 5000 rad affected the egg hatch of pupation period C (late). Irradiation of diapausing larvae appeared to affect the motility or viability, or both, of sperm instead of inducing lethal gene mutations. (Auth.)

1380 Rockstein, M., Bhatnagar, P.L. x-IRRADIATION AND WING RETENTION IN THE COMMON HOUSE FLY, Musca domestica L. Naturwissenschaften 53, 24 (1966) 702-703. (In English)

Different x-ray doses varying from 10 000 to 30 000 rad were administered to batches of 2500 42-h-old pupae. The number of deaths and degree of wing retention were recorded daily for all successfully emerging adults, and wing loss data were tabulated. High doses of x-rays acted in a restorative fashion, with regard to the normal aging process of the adult, by increasing longevity and by delaying the otherwise characteristic loss of wings early in adult life. The degree of such enhancement increased with dose level, up to 30 000 rad. In the control group, only 7% of 1196 males died with 100% intact wings, while 73% showed complete wing loss. At 30 000 rad 96% of (only) 274 successfully emerged males showed complete wing retention, whereas all of the 208 emerged females showed complete wing retention at death.

1381 Rockstein, M., Dauer, M., Bhatnagar, P.L. FURTHER STUDIES ON THE EFFECT OF x-IRRADIATION ON THE HOUSE FLY, Musca domestica L. Radiat. Res. 31 (1967) 840-845.

Exposure of 36- to 48-h-old pupae of the common housefly, M. domestica L., to single doses of x-rays ranging from 2000-8000 rad had no appreciable effect on the percentage of emergence or on the normal appearance of the adult flies. All levels of radiation produced only a slight but significant decline in female life span. Such low levels of x-irradiation produced only a slight effect on male life span, with a decrease for 2000 rad, no effect at 4000 rad, and a slight increase at 6000 and 8000 rad. However, the effect of such x-irradiation on the otherwise normally high degree of wing loss in male houseflies was much more striking, the number of male houseflies retaining their wings at the time of death being trebled for all four dose levels studied. In the females, there was a smaller but nevertheless significant increase in such wing retention. (Auth.)

1382 Sasaki, S. EFFECTS OF x-IRRADIATION ON POSTEMBRYONIC DEVELOPMENT OF Sarcophaga peregrina Robineau-Desvoidy. Dobutsugaku Zasshi (Zoological Magazine) 75 (1966) 207-214. (In Japanese)

When larvae were x-irradiated with 0.5-50 kR, they were not killed and developed to prepupae. Irradiation of larval and prepupal stages caused death in the early pupal stage (early death); disturbance in exchange of the hypodermis was observed. When pupae were irradiated at 20 h of age or later, development continued but emergence did not occur because of general suppression of differentiation (late death). Radiosensitivity, when determined by the emergence rate, was scarcely altered during the period from 2nd-instar larva to 2nd-day pupa and thereafter it dropped off gradually. The most radiosensitive stage was 30 to 50-h-old pupae; fully grown 7th-day pupae were about 56 times as radioresistant as that of 1st-day pupa. The change in DNA synthesis rate was correlated with the change in radiosensitivity of the pupal stages except for the late pupal stage. Results of partial body irradiation of 1st-day pupa were also reported. Irradiation of the head and thorax had an equivalent effect to whole-body irradiation; irradiation of the head had the greatest effect. (NSA 21:1967, 22752)

1383 Schneider-Minder, A. CYTOLOGISCHE UNTERSUCHUNGEN ZUR DEUTUNG DER UNTERSCHIEDLICHEN STRAHLENEMPFLINDLICHKEIT VERSCHIEDEN ALTER Drosophila-EIER. (Cytological investigations to interpret the differential radiosensitivity observed in Drosophila eggs of different ages.) Arch. Julius Klaus-Stift. Vererb-Forsch. 37 (1962) 38. (In German)

1384 Schneider-Minder, A. CYTOLOGISCHE UNTERSUCHUNG DER EMBRYONALENTWICKLUNG VON Drosophila melanogaster NACH RÖNTGENBESTRAHLUNG IN FRÜHEN ENTWICKLUNGSSTADIEN. (Cytological study of embryo development in Drosophila melanogaster, following x-irradiation at early developmental stages.) Int. J. Radiat. Biol. 11, 1 (1966) 1-20. (In German, with English and French summaries)

Eggs of D. melanogaster were x-irradiated at two stages of different radiosensitivity of the 1st cleavage division (inter-/prophase and ana-/telophase) each stage receiving a different dose (1000 R or 650 R, respectively). This resulted, in spite of the differences in radiosensitivity, in approx. equal rates of embryonic mortality (about 85%). Regardless of the stage irradiated, approx. 80% of the eggs died in early stages of embryonic development, i.e. before blastoderm formation, and approx. 5% died in late stages of embryonic development. At different times after irradiation eggs were fixed and investigated cytologically. Regardless of the stage irradiated, the same lethal syndromes occurred. Those eggs, which die in early phases of embryonic development, exhibit one type of a rather uniform lethal syndrome only: first the multiplication of nuclei ceases, then that of chromosome division; finally the increase in number of protoplasmic islands comes to an end. Before disintegrating, these eggs usually contain eight nuclei, which seem to be mostly octoploid; the larger part of the eggs has 64 protoplasmic islands. The main cause of the lethality is probably an induced mitotic block, which itself could at least partly be caused by chromosomal bridges. Among the eggs, which die late in embryonic development, very different syndromes were recorded, which can manifest themselves at stages from the preblastoderm to very late embryonic development. These syndromes are probably brought about by different radiation-induced losses of either whole chromosomes or of chromosome parts; they may also be caused by alterations in the informational content of the genome. (Auth. summary)

1385 Shim, J.W., Hyun, J.S. SOME EFFECTS OF x-RAY IRRADIATION ON THE RICE STEM BORER. J. nucl. Sci. Korea 6 (1965) 193-199.

1386 Tahmisian, T.N. BIOCHEMICAL AND DEVELOPMENTAL RESPONSE OF GRASSHOPPER EMBRYOS AND SPERMATOGONIA TO x-IRRADIATION. Argonne nat. Lab. Rev. 2, 3 (1965) 52-53.

The effects of doses of x-radiation ranging from 25 to 200 kR, on respiration and development of grasshopper embryos were studied, with emphasis on the radiosensitivity of various organizational stages including induction, differentiation, cell division or multiplication, anabolism, and catabolism. Degrees of complexity at each organization level are discussed and the interdependence of all factors is considered. Results are included from an electron microscopic study of normal spermatogenesis in the grasshopper and the effects of x-radiation on spermatogenesis. (NSA 19: 1965, 38813)

1387 Teravskiĭ, I.K. THE EFFECT OF IONIZING RADIATION ON ARGASID TICKS. Zool. Zh. 45 Pt.3 (1966) 371-374. (In Russian, with English summary)

The following is substantially the English summary. In experiments in Leningrad, larvae, nymphs and adults of Ornithodoros tholozani (Lab. & Mégn.) (papillipes (Bir.)) infected with Borrelia persica (sogdiana) were exposed to γ-radiation from a ^{60}Co source. Doses of 2000 R were lethal to the larvae and inhibited metamorphosis of the nymphs. Doses of 5000-10 000 R were not lethal to 3rd- and 4th-instar nymphs or adults, but they greatly reduced metamorphosis of the nymphs, and eggs laid by irradiated adults failed to develop. Metamorphosis of the offspring of irradiated ticks was delayed. Doses up to 10 000 R were not lethal to the spirochaetes in the infected ticks. (RAE-B 56: 1968, ref. 58)

1388 Teulade, P. RECENTES EXPERIENCES DE RADIOBIOLOGIE SUR Bombyx mori. Atom. Energy Rev. 4, 2 (1966) 3-57.

Due to its physiological characteristics (embryonic diapause, synchronous gamete development) and its great genetic variability, B. mori constitutes excellent material for studying the effects of ionizing radiations. The use of numerous criteria (mortality, duration of embryonic development, and histological and biochemical analyses) has made it possible to follow the variations in radiosensitivity as embryogenesis proceeds. It has likewise been possible to define the respective roles of diapause and of hibernation (particularly the effect of aging). Various studies of the embryo have further contributed valuable data on the effect of the mode of irradiation (dose fractionation and rate), and of LET, and have demonstrated the vital role of recovery. The effects of ionizing radiations on the progress of gametogenesis were tested by histological and genetic methods (particularly that of specific loci). The effect of the mode of irradiation and LET were studied on some particularly sensitive stages (e.g., advanced spermatogonia, type VI; spermatocytes at the end of meiotic prophase). The results obtained explain the processes involved in radio-induced mutagenesis and stress the significance of recovery. Radiobiological studies have also contributed to a better understanding of some physiological aspects of B. mori.

1389 Thompson, R.C. et al. RADIATION EFFECTS: GENERAL. p. 1-19 of "Pacific Northwest Laboratory Annual Report 1966 to the USAEC Division of Biology and Medicine. Vol.1. Biological Sciences". BNWL-480, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Jul. 1967, 207p.

Data are presented on the mechanism and treatment of gastrointestinal radiation effects. Two papers discuss the effects of x-radiation on larval and pupal stages of flour beetles.

1390 Tilton, E.W., Burkholder, W.E., Cogburn, R.R. EFFECT OF GAMMA RADIATION ON Trogoderma glabrum AND Attagenus piceus. J. econ. Ent. 59, 4 (1966) 944-948.

A study to determine the gross effects of γ-radiation on T. glabrum (Herbst) and the black carpet beetle, A. piceus (Olivier), was conducted. All metamorphic stages of the insects were treated with 13.2 ± 10%, 17.5, 25, 45, and 100 krads or with 13.2 krads ± 10% repeated 5 times at hourly intervals for a total of 66 krads ± 10%. Each week mortality, developmental progress, and reproduction by treated individuals were checked. Eggs and larvae of both species were controlled effectively by all dosages. However, no dosage used was enough to produce complete mortality immediately of any of the stages of either species. Reproduction in both species was limited in the F_1 generation to the insects where the P_1 generation received the lowest dosage. Indications are that males of both species when treated directly were less subject to genetic damage than the females. Genetic damage, as evidenced by reduced reproduction, was transmitted to the F_1 generation of T. glabrum. (Auth.)

1391 Tilton, E.W., Burkholder, W.E., Cogburn, R.R. EFFECTS OF GAMMA RADIATION ON Rhyzopertha dominica, Sitophilus oryzae, Tribolium confusum, AND Lasioderma serricorne. J. econ. Ent. 59, 6 (1966) 1363-1368.

Lesser grain borers, R. dominica (F.); confused flour beetles, T. confusum Jacquelin duVal; rice weevils, S. oryzae (L.); and cigarette beetles, L. serricorne (F.), were exposed to various levels of γ-radiation from a ^{60}Co source. All four metamorphic stages of each insect were used. Dosages were 13.2-10%, 17.5, 25, 45, and 100 krad and, on all insects except the lesser grain borer, a fractionated dosage of 13.2 krad ± 10% repeated five times at hourly intervals. The dose rate for all treatment levels was about 330 krad/h. In all species the adults were the most tolerant, followed by the pupae, then the larvae, and then the eggs. No dosage used was high enough to produce immediate complete mortality of all species. All four species were sterilized by γ-radiation in a single continuous dose of 25 krad or more. (Auth.)

1392 Vasilyan, V.V. THE EFFECT OF IONIZING RADIATION UPON THE DEVELOPMENT OF THE MALLOW MOTH. Ent. Rev. 39 (1961) 425-428. (In English) Ent. obozr. 39, 3 (1960) 599-604. (In Russian)

Effects of x-rays on the mallow moth Pectinophora malvella, the larva of which feeds on cotton plants and is an economic pest, was investigated. Irradiation of raw cotton being shipped to uninfested areas was considered as a means of preventing spread of this insect. Caterpillars were irradiated with 1000- to 15 000-R doses of 180-kV x-rays. A dose of 1000 R apparently had no effect on the development of the caterpillars, since the emerged moths were normal and had an almost identical egg production. Starting with a dose of 5000 R, x-rays had a deleterious action. Thus, of the 80 caterpillars irradiated with doses of 5000 R only one of the moths that emerged was apparently normal, while the rest were malformed. These malformed moths died 1-3 d after emergence and did not oviposit. Thus, when wintering caterpillars were irradiated in their cocoons at the beginning of May, doses of 5000 R and higher were lethal to the moths that emerged while doses of 10 000 R and higher killed the caterpillars before they could leave the cocoons. In contrast, last-stage caterpillars of the summer generation were found to be relatively resistant to x-rays. Doses of 5000 R and higher sharply decreased the fecundity of the moths or rendered them completely sterile. Doses of 10 000 R and higher were lethal for the caterpillars. In irradiation experiments with summer generation caterpillars feeding on cotton, up to 15% went into diapause. A dose of 1000 R had almost no effect on the development of the mallow moth. No difference was noted between the effects of irradiation of last-stage caterpillars and summer generation pupae. The doses used had no apparent effect on the longevity of the moths. (NSA 20: 1986, 9349)

1393 Vasilyan, V.V., Alaveryan, E.B., Edigaryan, S.E. STUDY OF THE EFFECT OF x-RAYS ON THE DEVELOPMENT OF THE MELON FLY. "Materialy Sessii Zakavkazskogo Soveta po Koordinatsii Nauchno-Issledovatel'skikh Rabot po Zashchite Rastenii. Erevan, Armenian SSR, 1967".

1394 Wixson, B.G., Clark, W.J. GAMMA RADIATION EFFECTS ON NYMPHS OF THE DAMSEL FLY Argia translata. Ann. ent. Soc. Am. 60, 2 (1967) 485-486.

Nymphs of A. translata Hagen in their final instar were collected from the river and irradiated in replicate sample groups of 10; radiation dosage was continuous, and administered at 710 rad/min. Median tolerance limit (TL_m) values were determined and plotted. Ti_m calculated from these data were: 24 h - 15×10^4 rad; 48 h - 92×10^3 rad; 72 h - 52×10^3 rad. An unusual phenomenon of accelerated emergence was noted in the groups which received 750 and 7150 rad, respectively. Adult emergence was 1% in the control groups during the 72 h of the experiment, yet 9% of the 750 rad group completed normal emergence during this period. In the 7150 rad group, 12% attempted emergence but only half completed it successfully, the others being unable to straighten the wings or the abdomen into the normal adult position. There was no emergence in groups given > 71 000 rad.

1395 Würgler, F.E. UNTERSUCHUNGEN ÜBER DIE STRAHLENEMPFINDLICHKEIT FRÜHER ENTWICKLUNGSSTADIEN VON Drosophila melanogaster. (Studies on the radiosensitivity of early embryonic stages of Drosophila melanogaster.) Thesis, Zürich Univ. (Switzerland), Naturwissenschaftliche Fakultät. 1964, 151p. (In German)

Newly deposited fertilized eggs of different ages were tested for their radiosensitivity, for various doses of 50 kV x-rays. In series I, 10-20 min old eggs were collected at 10 min intervals and irradiated for 3 min. Dose-dependence. After irradiation in air at room temperature, embryonic and post-embryonic mortality rates and recessive lethal factors in the X-chromosome gave exponential dose-effect curves. These curves had previously been interpreted as one-hit curves, such that the radiation-induced point mutations as well as chromosome breaks and their results represent the basic cause of all effects registered. Genetic effects in the reproductive tract of surviving imagos: 1000 R produced 13.3% viability-reducing mutations in the X-chromosome, amongst them 5.3% recessive lethals. The rate of reciprocal II/III-translocations, on the other hand, were extremely low (0.5%). Oxygen effect. Newly laid eggs are not damaged lethally when they are deprived of O for a max. of 7 min. The O content of the egg adapts to the gaseous environment within 15 sec. The dose-effect curves for embryonic and post-embryonic mortality and recessive lethal factors in the X-chromosome were flattened when irradiation took place in N instead of air. All curves were exponential. Cold treatment after irradiation, at temperatures between +10 and +3 °C for 30 min immediately after irradiation at room temperature, lowered embryonic mortality. In series II, eggs were collected at 3 min intervals of oviposition, and irradiated for 3 sec at various times after collection. Egg sensitivity, in terms of embryonic mortality after a particular dose, changed from minute to minute during early embryo development. Cytological analysis of non-irradiated eggs at various intervals after oviposition permitted the various radiosensitivities to be correlated with particular mitotic stages. The eggs were most sensitive during late ana- and early telophase, but relatively insensitive in interphase. Killed embryos could be recognized (a) at the early embryonic stage by their death prior to gastrulation, and (b) late embryonic, by dying after gastrulation, both lethal syndromes being recognizable visibly. Dose-effect curves were drawn for eggs of various ages, for early and late embryonic mortality. It could be shown that the exponential dose-effect curves for embryonic mortality of 10-20 min old eggs cannot be interpreted as one-hit curves. The exponential dose-dependence is the result of the superimposition of non-exponential curves (dose-effect curves for different lethalities of various mitotic stages present during irradiation). Radiation effects did not confirm the hypothesis of Lea and Ulrich according to which such effects are due to chromosomal aberrations. The radiation effects observed did not depend on the chromosomal constitution of the nucleus to that extent. It was concluded that non-chromosomal radiation effect may lead to death of the irradiated individual, a hypothesis supported by additional data. It appears probable from the results of cold-posttreatment and from the dose-effect curves for early and late embryonic lethality, that protein synthesis plays a significant role in the development of biologically identifiable radiation effects.

1396 Yüpares Permswang. EFFECT OF GAMMA IRRADIATION ON THE DEVELOPMENT AND STERILITY OF ANGUMOIS GRAIN MOTH (Sitotroga cerealella Oliv.) p. 48-52 of "Insect Eradication by Irradiation, Bangkok, Thailand, 28-29 Jun, 1966". THAI. AEC-8, Office of Atomic Energy for Peace, Bangkok (Thailand).

A dose of 1000-4000 rad had little effect on rate of development. It was retarded by 8000 rad in 8-, 12-, 16-, 20- and 24-d-old cultures. The number of eggs per female decreased with increasing dosage and age. No eggs hatched from cultures aged 12, 16, and 20 d when exposed to 8000 rad. This suggests that sterility of both sexes should be obtained around 8000 rad. Further experiments are required to decide whether Sitotroga is suitable for control by the sterile male technique.

1397 Ziad Al-ahmadi, A. EFFECTS OF GAMMA RADIATION ON DEVELOPMENT OF Dermacentor occidentalis (IXODIDAE). Bull. ent. Soc. Am. 13, 3 (1967) 200. Abstr. 285, at "New York Meeting of the Entomological Society of America, New York, N.Y., USA. 27-30 Nov. 1967".

The effects of γ-radiation from ^{137}Cs source on development, fertility, and mutagenesis in two species of mites and ticks are being studied. Preliminary data on the development of embryos, larvae and nymphs of D. occidentalis irradiated at various dosages from 100-15 000 rad are discussed. (Abstr.)

See also:

26 The effect of thymidine-^{3}H on the mortality of Drosophila melanogaster larvae. (Anil, Y.D., 1964)

532 Radiation profile of a herbivorous insect. (Reichle, D.E., 1966)
923 Nucleic acids in normal and γ-rays irradiated eggs of Bombyx mori. (Lassota, Z., 1967)
928 Cytological evaluation of dose-rate effects of radiation on mutation frequency of silkworm gonia. I. Kinetics of proliferation and killing of spermatogonia during chronic irradiation. (Sado, T., 1966)
940 Radiomutability and heterogeneity of male germ cells of Drosophila before, during, and after meiosis. (Fritz-Niggli, H., 1966)
941 Biological effects of radiation. (Grosch, D.S., 1965)
953 The radiosensitivity of germ cells. (Mandl, A.M., 1964)
957 Annual Report of the National Institute of Genetics, No.16, 1965. (National Inst. of Genetics, Mishima, Japan, 1966)
963 Techniques for studying the effects of radiation on meiosis and related processes in mosquitoes with particular reference to Aedes aegypti. (Rai, K.S., 1968)
987 Etude de l'effet génétique des rayonnements ionisants chez le ver à soie. (Akhalaya, Y.G., 1967)
990 Cytogenetic and developmental effects of gamma-irradiation on Aedes aegypti L. (Asman, M., 1966)
1010 Genetic and direct effects of gamma radiation on Drosophila. (Ives, P.T., 1966)
1044 Effect of ionizing radiation and incidence of triplo-X females in offspring of attached-X Drosophila melanogaster. (U, R. et al., 1967)
1061 Effect of ionising radiation on the ontogenetical development and sex of the Bomyx mori. (Dinu, M. et al., 1966)
1062 Dependence of radiation induced mutation rate on maturity and dose for chrysalis of Drosophila melanogaster Meigen. (Ebeling, W., 1962)
1103 Mutant traits of the larval and pupal stadia of the wax moth. (Smith, T.L., 1967)
1123 Effectiveness of sterilization of the mallow moth; irradiability at different stages of development, and certain features of mating and egg-laying. (Buginsky, V.I., 1963)
1131 Sterilization of the coffee leaf miner. (Katiyar, K.P., 1967)
1132 Sterilization of parasites of the ash tree. (Khvatova, L., 1965)
1144 Biology and radiation sterilization of sugar cane leafhoppers. (Osborn, A.W. et al., 1966)
1149 Radiation sterilization of sugar-cane leafhoppers of the family Delphacidae. (Shipp, E. et al., 1966)
1158 Gamma-induced sterility in the sugarcane moth, [Diatraea saccharalis (Fab.) (Lepidoptera: Grambidae)]. (Walker, D.W. et al., 1967)
1175 Influence of arginine of radiation damage of spermatids and spermatocytes in Drosophila. (Abeleva, E.A., 1965)
1218 Thymidine teratogenesis and mutagenesis in Drosophila melanogaster. (Parkash, O., 1967)
1233 Effect of aeration on gamma irradiation of house fly pupae. (Smittle, B.J., 1967)
1258 Sterilizing effect of γ-rays and apholate on the Mexican bean beetle, Epilachna varivestis Muls. (Carillo, J.L. et al., 1963/1964)
1294 Spermatogenesis in drones following irradiation of the young larvae with different amounts of x-rays. (Bischkopf, R., 1966)
1297 Engorgement and reproduction of lone star ticks (Amblyomma americanum (L.)) treated with gamma radiation. (Drummond, R.O. et al., 1966)
1302 Effects of gamma radiation on fertility, mating, and longevity of males of the oriental fruit moth, Grapholitha molesta (Lepidoptera: Tortricidae.) (George, J.A., 1967)
1307 Laboratory and field cage studies of the effects of gamma radiation on codling moths. (Hathaway, D.O., 1966)
1312 x-Ray-induced mutability of polygenes controlling hatching time in Drosophila melanogaster. (Pulitzer, J.F., 1966)
1325 A cytological study of the effects of radiation on the development of the reproductive organs of two species of fruit flies, Dacus oleae and Ceratitis capitata; part of a co-ordinated programme of insect control using radiation. Research contract 169. (International Atomic Energy Agency, Vienna, Austria, 1967)
1332 The male reproductive system and spermatogenesis of the European pine shoot moth, Rhyacionia buoliana (Lepidoptera: Olethreutidae), with observations on the effect of gamma irradiation. (Shen, S.K. et al., 1967)
1398 Effect of radiation on the developing flour beetle, Tribolium confusum. (Buckhold, M. et al., 1967)

1399 Variations du spectre d'anomalies consécutives à une irradiation X chez l'embryon de Bombyx mori en fonction de l'hivernation préalable. (Coulon, M., 1966)

1415 The relationship between age at irradiation and life-shortening in adult Drosophila. (Lamb, M.J., 1966)

1421 Differential gerontomimetic effects of x-irradiation to pupae of male and female house flies. (Rockstein, M., 1966)

1422 Differential gerontomimetic effects of pupal x-irradiation of adult male and female house flies. (Rockstein, M. et al., 1966)

1428 The susceptibility of the red flour beetle, Tribolium castaneum (Hbst.) to gamma radiation. (Bhuiya, A.D. et al., 1967)

1434 Acute lethality after x-irradiation of Tribolium confusum adults. (Ducoff, H.S. et al., 1967)

1436 Study of the irradiation tolerance of some destructive storehouse insects and technical and economic aspects of insect destruction by irradiation. (Farkas, J., 1965)

1438 Lethal and mutation rates in newly laid x-irradiated Drosophila eggs at different oxygen concentrations. (Finsinger, F.X., 1964)

1441 Observation on the effects of γ-radiation on eggs of the desert locust, Schistocerca gregaria (Forsk.) (Hunter-Jones, P. et al., 1966)

1442 The effects of x-ray irradiation on the pupal mortality and hatchability of the rice stem borer. (Shim, J.W. et al., 1967)

1444 Studies on the use of gamma radiation in the control of pea weevil Callosobruchus chinensis L. (Srisan Ruangpas, 1966)

1446 The mortality effect of radiation on Drosophila melanogaster larvae of different ages. (Ucer, E., 1965)

1447 Preliminary study on the effect of gamma radiation in controlling oriental fruit fly (Dacus dorsalis Hendel) in banana. (Krithayakiem, V., 1966)

1450 Influence of incubation conditions on the radiobiological effects on eggs of Bombyx silkworms. (Akhalaya, Y.G., 1966)

1462 Influence of diapause on the radiosensitivity of khapra beetle larvae. (Rahalkar, G.W. et al., 1966)

1471 The effects of gamma radiation on mating competitiveness and fecundity of Hippelates pusio Loew. (Flint, H.M., 1966)

1484 Action des radiations ionisantes naturelles sur la reproduction des métazoaires: recherches chez Drosophila melanogaster. (Planel, H. et al., 1967)

1514 An estimate of the effects of fallout beta radiation on insects and associated invertebrates. (Teresi, J.D. et al., 1966)

1583 Studies of the eradication of Anopheles pharoensis Theobald by the sterile-male technique using cobalt-60. I. Biological effects of gamma radiation on the different developmental stages. (Abdel-Malek, A.A. et al., 1966)

1584 Studies of the eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. III. Determination of the sterile dose and its biological effects on different characters related to "fitness" components. (Abdel-Malek, A.A. et al., 1967)

1593 Control of fruit flies Dacus zonatus Saunders by gamma-rays. (Huque, H. et al., 1967)

1608 Study of the biology, breeding and sterilisation of the cabbage fly, Phorbia brassicae Bouché, with special reference to its occurrence in radish cultures. (Riedel, M., 1967)

1622 Studies on the application of the sterility method in the tick Ornithodoros tholozani. (Galun, R. et al., 1967)

1662 Radiation disinfestation of grain and seeds. (Golumbic, C. et al., 1966)

1666 The Israel food irradiation programme and progress during 1964-1966. (Kahan, R.S. et al., 1966)

1668 Food irradiation research and pilot facilities in operation or planned in India. (Kumta, U.S. et al., 1966)

1670 Control of the Queensland fruit fly by gamma irradiation. (MacFarlane, J.J., 1966)

1677 "6th Annual AEC Food Irradiation Contractors Meeting, Washington, D.C., 3-4 Oct. 1966". (Mayer, E.L. et al., 1966)

1693 x-Ray irradiation effects on storehouse destructive insects. (Török, G. et al., 1959)

2.2.5. Malformations. Histopathological Changes

1398 Buckhold, M., Slater, J.V. EFFECT OF RADIATION ON THE DEVELOPING FLOUR BEETLE, Tribolium confusum. p. 43-51 of "Joint NASA-AEC Program in Space Radiation Biology. Progress Report, Fall 1967". UCRL-17751, California Univ., Berkeley. Lawrence Radiation Lab. Sep. 1967, 143p.

An interesting developmental abnormality has been studied. When irradiated with 2000 R of x- or γ-rays, young pupae develop into adults with a wing abnormality which consists of a median elytral split, elytral blistering, and protrusion of the underlying membranous wings. One or more of these effects are observed with varying degrees of severity as the dose is lowered. For 16-24 h old pupae, a dose response curve to 180-keV x-rays may be obtained which shows an extreme shoulder, a very sharp response at > 1200 R, and an ED-50 of 1430 R. Various physical and chemical parameters have been studied. Temperature had a synergistic effect. Sensitivity to x-rays (% of wing abnormality) varied with the age of the beetles. A delay in development (eclosion) has been found in 1-24 h old pupae. Eclosion delay appears to be a necessary but not sufficient condition for a wing abnormality. Various graphs are given. The effect of combining increased gravity and irradiation has not yielded any reliable results as yet.

1399 Coulon, M. VARIATIONS DU SPECTRE D'ANOMALIES CONSECUTIVES A UNE IRRADIATION CHEZ L'EMBRYON DE Bombyx mori EN FONCTION DE L'HIVERNATION PREALABLE. C. r. hebd. Séanc. Acad. Sci., D 263, 16 (1966) 1153-1155.

Les irradiations par rayons X ont été effectuées dans les conditions suivantes: 80 kV, 10 mA, filtre 2 mm/Al, débit 50 R/min ± 1. Les embryons sont irradiés à des stades un peu antérieurs à la blastocinèse aux doses suivantes 0 (témoins), 1000, 2000, 3000, 5000 R, et replacés dans les conditions normales d'incubation (22°C, 80% d'humidité); les embryons sont ensuite observés à des stades postérieurs à la blastocinèse où l'on détermine les anomalies qui les affectent. L'auteur distingue entre plusieurs types d'anomalies. Si le vieillissement est le seul facteur agissant, certaines anomalies (types III, VII et IV) n'apparaissent jamais. La fréquence de certaines anomalies (III, VI, I, XIII) augmente aussi bien sous l'action de l'irradiation que sous celle de l'hivernation préalable à l'irradiation. D'autres anomalies (II, VII, XIV) voient leur fréquence augmenter puis diminuer, selon la durée de l'hivernation préalable. Une anomalie (IV) très fréquente, après une irradiation et une courte hivernation, est de plus en plus rare au fur et à mesure que l'hivernation préalable s'allonge. Enfin le spectre des anomalies obtenues chez les témoins après 343 jours d'hivernation n'est pas significativement différent de celui obtenu dans les mêmes conditions chez les irradiés. L'examen des spectres obtenus en considérant les nombres d'anomalies rapportées au nombre total d'embryons étudiés confirme ces diverses conclusions.

1400 Coulon, M. ETUDE DU SPECTRE D'ANOMALIES CONSECUTIVES AU VIEILLISSEMENT ET A DES IRRADIATIONS X CHEZ L'EMBRYON DE Bombyx mori. Thesis, Lyon Univ. (France). Faculté des Sciences. 21 Jun. 1966, 97p.

A technique has been developed for mounting embryos of B. mori in toto, which allows the stages in embryogenesis to be determined at the moment when irradiation takes place. Various morphological anomalies of different organs (digestive tube, nervous system) have been noted and described. They are induced either by irradiation (x-ray doses from 1000-5000 R) or by being kept at 5°C, and aging beyond the time of diapause. The teratogenic effect seems to be proportional to the dose of radiation, at least for medium aging. Qualitatively, these anomalies do not vary as a function of the stage at which irradiation takes place (within the limits of stages D-F), nor of the dose. A spectrum of anomalies has been described as a function of the period of hibernation (which follows diapause and precedes irradiation). Several kinds of anomaly can be distinguished: those of the digestive system (tube) (types I-VI), those of the nervous system (VII-X) and "miscellaneous" (XI-XIII, which include effects on the labium, mandibles, and the silk gland). Various graphs are given, to illustrate the evolution of this anomaly spectrum as a function of hibernation. For certain anomalies irradiation is necessary, aging having a sensitizing action in some cases. Other anomalies occur as the result of extended conservation of the eggs in the cold, or following irradiation, regardless of the period of hibernation. Aging and x-rays can then have a comparable or a cumulative effect. Both irradiation and aging have a damaging effect on the physiology of the embryo. The mechanism of action is not understood.

1401 Lassota, Z. INTESTINAL DAMAGE AND WATER IMBALANCE IN GAMMA-IRRADIATION LARVAE OF Bombyx mori. Bull. Acad. pol. Sci. Cl. II Sér. Sci. biol. 14, 5 (1966) 293-296. (In English)

Larvae of the "warska" race of silkworm were irradiated 2-3 d after the 4th moult with single doses of 20, 65 or 200 kR of ^{60}C γ-rays, and compared with controls. The only significant difference found in larval blood 1-2 d after irradiation was the abrupt decrease of the values estimated by the anthrone method observed in 200 kR irradiated larvae. The level of reducing substances determined by the Hagedorn-Jensen method remained unchanged in the blood of such larvae. The decrease in reducing substances found by both methods in 20 and 60 kR-treated larvae was noticeable only 5-6 d after irradiation, i.e. at a time when the body weight in both groups was substantially lower than in controls. The guts of such larvae were swollen and contained more liquid than normal ones. In the 200-kR-treated larvae examined 1-2 d after irradiation the gut tissue was very fragile. The radiosensitivity of insect gut may be explained in terms of mitotic death, since the degeneration and replacement of midgut cells is known to be very rapid. The inhibition of this renewal by irradiation would result in damage to the merocrine and holocrine secretion of digestive enzymes as well as in disturbance of peritrophic membrane formation, both processes depending upon the normally functioning midgut epithelium. The deteriorating digestion and resorption of food would be reflected in the blood composition and total weight of the animals, as observed in 25 and 65 kR-treated larvae. The acute effects of a 200 kR dose of γ-rays may be only partially due to the severe intestinal damage. The loss of water by evaporation from the body surface may contribute seriously to the rapid loss of body weight of the survivors. The inappetance following this dose restricted the amount of water taken up with mulberry leaves, and the severe damage to the intestine, as indicated by the fragility of gut tissues, prevented the digestion of food present in the gut.

1402 Nur, U. REVERSAL OF HETEROCHROMATIZATION AND THE ACTIVITY OF THE PATERNAL CHROMOSOME SET IN THE MALE MEALY BUG. Genetics 56, 3 Pt. 1 (1967) 375-389.

Planococcus citri (Risso), Pseudococcus obscurus Essig and P. gahani Green were used. In mealybugs (Coccoidea: Homoptera) with the lecanoid chromosome system, the haploid set of chromosomes which is contributed by the father becomes heterochromatic in male embryos. Cells in some of the male tissues lack the heterochromatic (H) set. This lack is shown to be the result of the reversal of heterochromatization, and the return of the H set to a euchromatic state. The types of cells in which this reversal takes place may vary from species to species, and the time of reversal of the H set may vary from tissue to tissue. The present study shows that the activities previously attributed to the H set can be explained by the activity of the paternal set following its return to a euchromatic state in some of the male tissues. Examination of several tissues of 3rd-instar males developing after 60 000 R paternal irradiation and hybrid males from the cross P. obscurus × P. gahani indicated that developmental abnormalities occurred mostly in those tissues in which the H set had previously undergone reversal. The external morphology of males is determined by cells in which the paternal set is heterochromatic. The hybrid males resembled males of the maternal species in their external morphology, supplying additional evidence that the H set is genetically inactive.

See also:

1125 Sterilization of the female adult of Nauphoeta cinerea, (Blattoidea), by means of x-rays. (Caprotti, M. et al., 1963)

1130 Antennapedia (SS^{Anp}), an homoeotic mutant of Drosophila hydei Sturtevant. (Gloor, H. et al., 1966)

1132 Sterilization of parasites of the ash tree. (Khvatova, L., 1965)

1294 Spermatogenesis in drones following irradiation of the young larvae with different amounts of x-rays. (Bischkopf, R., 1966)

1336 1re Thèse. Etude du développement post-embryonnaire de l'ovaire chez Ephestia kühniella Z. (Lepidoptera, Pyralidae). Effets des radiations ionisantes. (Baroughi-Bonab, H., 1965)

1357 Some effects of x-irradiation on larvae of Galleria mellonella. (Harshbarger, J.C. et al., 1966)

1377 Effect of sub-lethal gamma on eggs, early, intermediate, and last instar larvae of the Angoumois grain moth, Sitotroga cerealella Oliv. (Qureshi, Z.A. et al., 1966)

1388 Récentes expériences de radiobiologie sur Bombyx mori. (Teulade, P., 1966)

1416 Observations on Drosophila given a high dose of protons. (Malich, C. W. et al., 1965)

1451 Analysis of the combined effect of magnetic fields, temperature and radiation on development. (Amer, N.M. et al., 1965)

1452 Results of biological experiments carried out under conditions of flight in ships vostok with participation of cosmonauts A.G. Nikolayev, P.R. Popovich, and V.F. Bykovsky. (Antipov, V.V. et al., 1964)

2.2.6. Senescence. Longevity. Fitness

1403 Abdul Matin, A.S.M. SUSCEPTIBILITY OF ADULT RICE WEEVIL, Sitophilus oryzae (L.) TO GAMMA RADIATION. p. 133-135 of "Proceedings of the Agricultural Symposium. Dacca, Pakistan, 13-14 May 1966". 1966, 166p.

An attempt was made to find the effects of γ-radiation from a ^{60}Co source on the adults of S. oryzae (L.). The weevils were exposed to doses of radiation of 5-100 kR. Doses of 10 kR or more caused 100% mortality within one month. (RAE-A 56:1968, ref. 871)

1404 Ayala, F.S. EVOLUTION OF FITNESS. I. IMPROVEMENT IN THE PRODUCTIVITY AND SIZE OF IRRADIATED POPULATIONS OF Drosophila serrata AND Drosophila birchii. Genetics 53 (1966) 883-895.

D. serrata and D. birchii flies were x-irradiated with 2000 R per generation for three generations. Two experimental populations of irradiated flies and one control population were started for each species at 25°C. After 51 d a sample of 300 flies was taken from each population to start 6 other populations at 19°C. The populations were maintained under conditions of intense competition, both among the larvae and among the adults. At 25°C, the irradiated populations of D. serrata decreased in size and in productivity during the first few weeks of the experiment. From the 6th to the 15th week they increased greatly in size and in productivity, and maintained their superiorities until the end of the experiment. The equilibrium levels were 50 or more % higher than that of the control. At 19°C the two irradiated populations of D. serrata were also superior to the control in productivity and in size from the 13th week until the end of the experiment. The two irradiated populations of D. birchii at 25°C increased in size steadily from the 5th week until the end of the experiment, exceeding the control population in productivity and in size by more than 50%. At 19°C there is no marked difference between the control and the irradiated population. - Regression analysis shows that there has been a continuous differential increase in the fitness of the irradiated populations of D. serrata at both temperatures, and in those of D. birchii at 25°C. It is concluded that an increase in genetic variability produced by high frequency radiation may, with natural selection, result in an increase in the rate of evolution of the population, and finally of the fitness of the population in new environments. (Auth. summary)

1405 Baxter, R.C., Blair, H.A. KINETICS OF AGING AS REVEALED BY x-RAY-DOSE-LETHALITY RELATIONS IN Drosophila. Radiat. Res. 30, 1 (1967) 48-70.

Median ages of death following sublethal doses and median lethal doses for acute lethality after 1 d were determined in relation to age of exposure, throughout normal life span, to 100-kV x-rays in D. melanogaster imagoes of both sexes. Both sets of data provide continuously decreasing functions of dose, D, with respect to age. Consequently D may be used as a single valued measure of age, and variations of functions of D with respect to age as rates of aging. Rates of aging as derived from either set of data are faster in the male than in the female and are inversely proportional to normal survival times, about 44 and 51 d, respectively, at the temperature used, 25°C. It is concluded that normal life span and rate of aging are fully determined on eclosion and are realized in the absence of unfavourable conditions. The injuries leading to acute and delayed death appear to affect different mechanisms, the former being wholly recoverable and not additive to the latter, which is irreparable at least in part. Doses below a certain level appear not to shorten life span, and extension of life span by exposure was not observed. (Auth.)

1406 Baxter, R.C., Blair, H.A. AGE OF DEATH IN Drosophila FOLLOWING SUBLETHAL EXPOSURE TO GAMMA RADIATION. Radiat. Res. 31, 2 (1967) 287-303.

Ages of death following exposure to* ^{60}Co γ-radiation were studied for doses permitting survival of at least several days in wild-type D. melanogaster imagoes of both sexes. Lethal injury, represented by $D + 0.003D^2$, where D is the radiation dose, is a linear function of the reciprocal of the age of death. The equations for the two sexes differ only in the slope constants, which are proportional to the normal survival times, about 44 and 51 d, respectively, for male and female at 25°C. Average or median life shortening in the two sexes is not equal for a given dose but is the same fraction of normal survival time. Life shortening for various deciles with respect to time of death tends to be equal for the female, but for the male the lives of those dying early are shortened relatively less than the lives of those dying late. Thus the responses of male and female populations are different. In accord with prediction from higher doses, doses below a certain value appear not to affect life span. (Auth.)

* (0 - 180 kR)

1407 Baxter, R.C., Blair, H.A. AGE OF DEATH IN Drosophila FOLLOWING SUBLETHAL EXPOSURES TO γ-RADIATION. p. 33-34 in "Brief Description of Research Published or Accepted for Publication During 1966". Annual Report UR-49-748, Rochester Univ., N.Y. Atomic Energy Project. Neuman, W.F., Rothstein, A., Eds. 1 Apr. 1967, 253p.

See 1406.

1408 Clark, A.M., Cole, K.W. THE EFFECTS OF IONIZING RADIATION ON THE LONGEVITY OF PLOIDY TYPES IN THE WASP Mormoniella vitripennis. Expl Geront. 2 (1967) 89-95.

The adult life span of M. vitripennis is influenced by the kinds of genes present rather than by the number of sets of chromosomes. Diploid males were more resistant than haploid males to ionizing irradiation. Diploid and triploid females were equal in radiation sensitivity. The data reported did not support the somatic mutation theory of aging and indicated further that the types of injury leading to natural aging were different from those leading to radioinduced decrease in life span. Although the data indicate that some type of nuclear injury is induced by ionizing radiation, the precise nature of the injury is still obscure. This is presumably because of the many physiological events that occur between initial radioinduced injury and death in a multicellular organism. (NSA 21: 1967, 41509)

1409 Clark, A.M., Osmun, D.E. ADULT LIFE SPAN IN Habrobracon serinopae AFTER x-IRRADIATION DURING EARLY DEVELOPMENT. Nature, Lond. 214 (1967) 717-718.

H. serinopae females, homozygous for the recessive mutant veinless wings (vl), were mated to veined (+) males. From the fertilized eggs, diploid progeny (+/vl, male and female), and from the unfertilized eggs, haploid males (vl) were obtained. A comparison of development and adult life span for these three types was made after x-irradiation during cleavage. The dose rate was 300 R/min of 75 kVp x-rays. The wasps were reared at 30°C. There was a decrease in egg hatchability with increasing dose as shown by the larva/egg ratios. Those embryos that became larvae showed no further injurious effects as shown by the pupa/larva and adult/pupa ratios between the control and irradiated groups. Adults showed no structural abnormalities. There was no consistent decrease in adult life span with increasing dose. Injury from irradiation was manifested at cleavage or not at all and haploid types were more radio-resistant than diploids.

1410 Erdman, H.E. MODIFICATION OF FITNESS IN SPECIES AND STRAINS OF FLOUR BEETLES DUE TO x-RAY AND DDT. Ecology 47, 6 (1966) 1066-1072.

Studies were designed to determine the early effects of DDT and x-radiation, singly and in combination, on mortality and productivity of flour beetle species and strains (Tribolium confusum Duval "Chicago standard" and T. castaneum Herbst "Brazil cl" and "Sooty"). Five replicate populations each containing ten pairs of virgin beetles x-rayed with 0, 1, 2 or 4 kR of x-rays (250 kVp, 30 mA, 0.25 mm Cu + 1.0 mm Al filtration, 0.86 mm Cu HVL and 2.5 inches between target and subjects produced 1 kR/min) were cultured under standard conditions in food containing 0, 5, 10, 20 or 50 ppm DDT. Every two weeks for six weeks parental mortality was recorded and living adults were placed on fresh comparable food. The old food was reincubated and F_1 adult biomass and numbers were the

measures of productivity. Parental mortality was (1) unaffected by x-rays, (2) increased for "Brazil cI" at 50 ppm DDT, and (3) greater for females than males but unrelated to radiation or insecticide. Productivity measurements decreased with increasing x-ray or DDT. Productivity of T. confusum was, in general, more radiation-sensitive than that of T. castaneum strains, whereas both T. castaneum strains were more DDT-sensitive than was T. confusum. Radiation of 4 kR was almost sterilizing to T. confusum; of T. castaneum strain "Brazil cI" left no F_1 at 50 ppm DDT. Proportions of lethals due to x-ray or DDT were considered genetic dominants and used to quantify the relationship between radiation and insecticide in combination. Observed lethality simulated that expected for genetic dominant lethal effects when "Chicago standard" and "Brazil cI" were stressed with x-ray plus DDT. In "sooty", observed lethality was consistently lower than that predicted on the assumption of dominant lethal effects; i.e. productivity was less adversely affected when both stresses were applied than that expected by multiplying the effects of singly stressed populations. Within a species "sooty" populations showed more lethality due to x-rays than did "Brazil cI" populations; DDT had the opposite effect. (From abstr.)

1411 Hungate, F.P. RESPONSE OF INSECTS TO RADIATION. p. 2 of "Pacific Northwest Laboratory Monthly Activities Report, March 1966, on AEC Division of Biology and Medicine Programs". BNWL-247, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Apr. 1966, 17p.

In an earlier experiment with flour beetles, the black-body colour mutant, Sooty, appeared more DDT-resistant than the wild strain, Brazil cI, and was reproductively more fit when stressed with DDT and x-irradiation. To verify this observation and to determine whether the resistance was clearly associated with body colour, a series of new tests were initiated making use of specific crosses of the Sooty mutant with other strains. Data are not yet available.

1412 Khakimova, R.K. EFFECT OF IONIZING RADIATION ON THE SURVIVAL RATE OF Agrotis segetum Schiff, AND ITS ABILITY TO BREED. p. 255-257 of "Voprosy biologii i kraevoi meditsiny vol. 4 (Problems of Biology and Regional Medicine). Tashkent, Akad. NAUK Uz. SSR, 1963". Translation: Referat. Zh. Biol. (1964) 12E73.

Larvae and pupae of the cutworm, A. segetum were irradiated in a γ-unit, using ^{60}Co as the source with a dose rate of 115 R/sec. After irradiation with doses of 1000-15 000 R, some of the larvae pupated, but the moths did not fly. After larvae had been irradiated with dosages less than 1000 R and pupae with 5000 - 7000 R, moths flew but did not lay eggs. Mating of normal females with irradiated males resulted in infertile egg masses because of the males' sterility. The author suggests that ionizing radiation be used to sterilise males and that these males then be released. (BA)

1413 Lamb, M.J., Maynard Smith, J. RADIATION AND AGEING IN INSECTS. Expl Geront. 1 (1964) 11-20.

1414 Lamb, M.J. THE EFFECTS OF x-IRRADIATION ON THE LONGEVITY OF TRIPLOID AND DIPLOID FEMALE Drosophila melanogaster. Expl Geront. 1 (1965) 181-187.

1415 Lamb, M.J. THE RELATIONSHIP BETWEEN AGE AT IRRADIATION AND LIFE-SHORTENING IN ADULT Drosophila. p. 163-174 of "Radiation & Ageing". Lindop, P.J., Sacher, G.A., Eds. London, England, Taylor & Francis, 1966.

All the work was done on adult flies given single doses of x-rays or ^{60}Co γ-rays. The results of experiments using young flies (2-6 d after emergence from the pupal stage) are outlined. With older flies it was found that the percentage reduction in the further expectation of life per unit dose was constant over part of the age and dose range, but there was some evidence that flies irradiated with high doses showed an increase in sensitivity with age. D. melanogaster and D. subobscura were used. The hypotheses that radiation accelerates the natural aging process or causes precocious aging are discussed and it is concluded that the data are more compatible with the accelerated aging hypothesis. It is suggested that the increase in sensitivity with increasing age at irradiation with high doses can be explained if irradiation causes two types of injury, one of which occurs immediately after irradiation and can be repaired, and one which is irreparable and has a delayed effect.

1416 Malich, C.W., Binnard, R. OBSERVATIONS ON Drosophila GIVEN A HIGH DOSE OF PROTONS. Drosoph. Inf. Serv. 40 (1965) 73.

The flies were very lethargic after the irradiation. It is extremely unlikely that the irradiation was so non-uniform that any of the flies escaped the high dose of 30 000 rad. The proton beam was scattered by 1/8" of carbon to produce a nearly constant flux over a circle of diameter 1 1/2", and only the central 1" disk was used. In addition, the beam was oscillated rapidly (several hundred cps) to smooth out any minute irregularities. The dose delivered corresponds to approx. 1260 protons per square micron, so that each chromosome should have received multiple hits. The median life of the flies after this dose of protons was shorter than normal, half dying in 18 d compared to the shortest period of 21 d observed for virgins under similar crowded conditions. The food was rather damp and since this dumpy strain gets stuck easily, the environmental conditions may have affected the lifetime more than the radiation. Consequently it is only concluded from this series that the sterilising effect was virtually complete. Degenerative effects associated with high radiation doses were evident in five flies sacrificed for histological studies. Two flies dissected 17 d after treatment had degenerate ovaries and their oogonia were vacuolated and necrotic. Live motile sperm were seen in the seminal receptacle of the fly taken from a vial with mates, while no sperm were found in one which had been without mates for a week. The three flies which lived 32 d were dissected, and showed more advanced degeneration of the ovaries and the oogonia than the younger pair. No sperm were seen in these flies, which had been without mates for 10 d. Further work with lower doses has suggested other non-reparable damage produced by protons, and some biochemical effects on the brain of adults are being investigated. (From DIS)

1417 Muller, H. J. MECHANISMS OF LIFE-SPAN SHORTENING. p. 235-245 of "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation". London, Academic Press. 1963.

Reasons are presented for concluding that spontaneous aging is a part of normal development caused, like most other developmental changes, by other factors than permanent genetic alterations such as point-mutation, deficiency, chromosome loss and inactivation, or segregation, even though it does involve the point-wise death of many individual somatic cells. These reasons comprise the partial reversibility of natural aging, and its independence of ploidy and of other features of chromosome structure. Judged by the same criteria, radioinduced shortening of the life span is an expression of point-wise losses of individual cells that are caused by actual genetic changes. That the changes are for the most part recessive, depending on either point-mutations, deficiencies, or whole-chromosome losses, is shown by results in Drosophila, Habrobracon, and plant material, when effects on individuals of different ploidy are compared. Tests of diverse kinds carried out with Drosophila having chromosomes of different structural constitution show clearly that the mechanism here at work is that of chromosome loss, caused by radioinduced chromosome breaks. It is believed that the same basic mechanism accounts also for most of the acute damage that is produced by radiation. (Auth.)

1418 Po-Chedley, D. S. THE EFFECT OF x-RAYS AND VISIBLE LIGHT UPON THE ONE DAY OLD MEAL WORM, Tenebrio molitor, EMBRYO. p. 179 of "Third International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun.-2 Jul. 1966, 263p". Abstr. 710. Also published as AED-Conf-226-121, Gmelin-Institut fuer Anorganische Chemie and Grenzgebiete, Frankfurt am Main (West Germany). 1966, 2p.

An attempt is made to examine the role of white light with respect to (a) the reported survival curve of x-irradiated meal worm; (b) a consideration of the possibility of white light as a photo-reactivating agent for the assumed resistance/recovery phenomena associated with the x-irradiated organisms; (c) obtaining greater detail of the embryological morphology and developmental characteristics. - The dose-effect results for the x-irradiated and visible light stimulated embryos are generally similar in that the survival curves are sigmoid. LD 50/8 for x-rays was 150 R, the visible light stimulus 1000 mW/cm^2. When, however, the x-irradiated embryos were counter-exposed to visible light an increase in survival time was noted for the embryos. (Work on the order of administering stimuli is being continued and their possible influence on the high-reserve titre of free amino acids.)

1419 Ratty, F. J. ESTIMATION OF SENSITIVITY OF Drosophila melanogaster TO RADIATION USING A THIRD-ORDER ROTABLE DESIGN. Three Year Comprehensive Report. SAN-529-3, San Diego State Coll., Calif. 1966, 24p.

Results are reported from a series of studies on the relation between survival of 1st-instar larvae of D. melanogaster and dose and time of x-radiation exposure. Radiosensitivity was estimated in 3 lines of inbred flies and the hybrids formed between them. Data are included on the correlation of

larvae survival to x-radiation with chromosome puffing pattern; the relation between age and non-disjunction in irradiated parents; mutation induction in Drosophila cultured on aged and non-aged medium supplemented with DNA irradiated with 150 kR; the mutability of loci in an X-chromosome duplication; and mutation induction in Drosophila cultured on a medium exposed to 150, 500, or 3000 kR γ-radiation. (NSA 20: 1966, 31036)

1420 Ratty, F.J., Lovellette, E.J. CHROMOSOME SUBSTITUTION AND RADIOSENSITIVITY IN Drosophila melanogaster. Radiat. Res. 30 (1967) 825-831.

The survival of 1st-instar random-bred, inbred, and hybrid larvae formed by reciprocal crosses, after 1200 R of acute x-irradiation has been evaluated. The results show that survival of the irradiated lines is lower than that of the control larvae, while that of the inbred lines is lower in all irradiated and control groups. The lack of differences between the irradiated random and the irradiated hybrid lines is interpreted to mean that genetic variability is probably not important at this dose level and that detrimental genes in the hybrid genotypes are recessive. An interaction effect between radiation and inbreeding is noted, and it is suggested that a maternal effect could play only a minor role in the determination of radioresistance in these experiments. (Auth.)

1421 Rockstein, M. DIFFERENTIAL GERONTOMIMETIC EFFECTS OF x-IRRADIATION TO PUPAE OF MALE AND FEMALE HOUSE FLIES. p. 175-178 of "Radiation & Ageing". Lindop, P.J., Sacher, G.A., Eds. London, England, Taylor & Francis. 1966.

Irradiation of 36-48 h old pupae causes a significant change in emergence and longevity only at > 10 krad. Data were obtained for dosages of 10, 15, 20 and 30 krad, at 2 krad/min. The effects of x-irradiation on female fly longevity was one of progressive shift of the survival curve to the left. Accompanying this is a continuing diminution in mean lifespan over the entire dosage range, and a quite marked decrease in max. lifespan after 20 krad and 30 krad. The effect on longevity of the emerged male is much more complex: the average lifespan increases for 10 and 15 krad; is equal to the control at 20 krad; and declines significantly on exposing pupae to 30 krad. A rapid increase in male mortality rate occurred when wing loss was at a maximum. After irradiation of pupae with between 2 and 10 krad there appears to be no increase in wing retention at time of death, but at 20 and 30 krad there is a successively greater increase (a virtual doubling of wing retention per 10 krad) leading to virtually 100% retention at 30 krad. In females, wing retention is not markedly affected up to 10 krad but there is a gradual increase thereafter, with complete wing retention at 30 krad. This motor ability of flight represents an amelioration of a senescence phenomenon resulting from irradiation at the pupal stage.

1422 Rockstein, M., Bhatnagar, P.L., Dauer, M. DIFFERENTIAL GERONTOMIMETIC EFFECTS OF PUPAL x-IRRADIATION ON ADULT MALE AND FEMALE HOUSE FLIES. "Colloquium on Radiation and Ageing. Semmering, Austria, 23 - 24 Jun. 1966". AED-Conf-212-1, Gmelin-Institut fuer Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany). 1966, 2p.

Batches of 2500-3000 pupae of Musca domestica L. were exposed to single doses of x-rays from 2000 - 30000 rad, such as to give a dose rate of 2000 rad/min. Emergence was then studied under constant temperature, humidity and lighting conditions. Following irradiation up to 10000 rad, % emergence was only reduced slightly; at 15000 rad by 20%; at 30000 rad by 80%. The male: female ratio for emergence increased progressively from 1:1 to 1:33 at 20000 and 30000 rad. For doses of 10000 and 15000 rad the mean life span of males was increased by > 25%, while in females the mean life span decreased progressively with increasing x-ray dosage to a life span < 50% of the control, at 30000 rad. The sex differential normally favouring the female is minimized by x-irradiation, the mean life spans of both sexes being virtually identical at the dose levels used.

1423 Shilenko, B.V. GENETICS OF A HETEROZYGOUS POPULATION OF Drosophila melanogaster. I. VIABILITY AND POPULATION FITNESS OF HETEROZYGOUS CyLcn/cnl10 CARRIER OF IRRADIATED CHROMOSOME cnl10. Genetika No. 6 (1965) 104-109. (In Russian)

A new method of determining the heterozygous effect of radiation induced mutations is described. Normal IInd chromosome of a male belonging to a balanced lethal population CyLcn/+^{cn}110 was marked with gene cn and then subjected to irradiation. Heterozygous individuals possessing normal chromosomes (marked cn 110) have been paired with individuals bearing non-marked chromosomes (+^{cn}110). Two crosses were carried out. The 1st cross CyLcn/cn110 × CyLcn/+^{cn}110 (chromosomes

cn110 being irradiated) represents the basis of the experimental population, while the 2nd cross CyLcn/cn110 × CyLcn/+^{cn}110 (chromosomes cn10 being non-irradiated) represent the basis of the control population. It was shown that the proportion of the irradiated chromosomes of the experimental population is the same as that of the nonirradiated chromosome of the control population. Viability variation of the irradiated chromosome in F_1 individuals CyLcn/cn110 slightly exceeds that of nonirradiated cultures. The decreased rate of the proportion CyLcn/cn110 in generations of both the experimental and the control population is the same. Proportion of marked genotypes in crowded cultures exceeds that of uncrowded ones. (Auth.)

1424 Sonnenblick, B. P., Rockford, D. A POSITIVE RELATIONSHIP BETWEEN LONGEVITY AND RADIORESISTANCE IN Drosophila melanogaster. Genetics 50, 2 (1964) 287-288.

Materials used were a vigorous Canton-S strain and a strain X^{C2} y B and y f attached-X with ring-X males. 1- to -3-d imagos were exposed to ^{60}Co, the dose rate 1500 R/h for 22 h/d. Doses were 0 R, 33 kR, 66 kR, 93 kR and 120 kR. Vials were maintained at 17°C, five pairs of flies per vial, with periodic changes of media and regular inspection of test organisms. In two experiments, the life spans of almost 1300 organisms were recorded. No larvae were ever noted in vials with irradiated imagos. - Data permit the following comments: (a) mean life span of the untreated Canton + strain is significantly lower than that of the mutant strain, in both sexes; (b) this relationship is repeated in the 33 kR samples and with females given 66 kR; (c) mutant males given 66 kR twice had a slightly higher average life span than did their + counterparts; (d) at the two highest doses employed, radioresistance of both strains becomes essentially comparable; (e) excluding controls of both strains, male longevity in all exposed samples was lower than similarly treated females; (f) with care, appreciable numbers of control flies will live more than four months, a rare few over five months. - A radiosensitive genetic complex in embryonic tissues may thus be radioresistant, to a certain degree of stress, in the nondividing tissues of the adult, with continuance of function and unexpected longevity. Radioresistance, utilizing life span as the parameter of choice, parallels longevity of untreated populations under our conditions and up to a 66 kR dose. Dose rate, repair of chromosomal breakage, and the comparative embryonal and imaginal tissue oxygen tensions are certainly other factors to be considered in evaluating results such as these. (Abstr.)

1425 Sonnenblick, B. P., Gartner, L. P. LIFESPAN STUDIES WITH STRAINS OF GAMMA-IRRADIATED Drosophila ADULTS. Radiat. Res. 31, 3 (1967) 612. Abstr. Eb-3. Presented at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

The Drosophila adult soma is an essential non-reproducing system, except possibly for haemocytes and certain gut cells. We utilise a Canton wildtype strain and occasionally another strain with mutant phenotype containing ring-X-chromosome males and attached-X females, karyotypes reportedly radiosensitive during developmental stages with much mitotic activity. Some modifications of regular culture conditions at 19°C are used which, compared with our previous similar studies, result in marked increase in mean lifespan and in extension of range of individual longevity. Young adults have been exposed to ^{60}Co at 25 and 9000 R/min and to doses of 0, 33, 66, 93, and 120 kR. Germ cells are disastrously affected, with few eggs laid and no development noted. Some comments are: (a) there is evidence of a dose rate effect; (b) after 33 kR at the low but not high dose rate, there is no significant difference between lifespan averages of exposed and control samples, evidencing recuperation; (c) non-irradiated females usually but not invariably have a higher average longevity than male counterparts, but in all 24 irradiation tests with both strains the mean female lifespan always was greater; (d) after 120 kR at low dose rate in both strains, some 40% females survive when all males have died; (e) a male was the last day survivor in 8 of 10 control trails but after varied exposures a female lived longest 23 of 24 possible times; (f) a karyotype and genome considered radiosensitive in preadult stages, noted above, may show a surprising longevity with adult carriers. Assuming comparable nuclear radiosensitivity in fixed, nondividing cells and in cells capable of reproduction, questions arise as to the significance of chromosome breakage with and without rejoining in the continued functioning of the fixed cells, or the significance, if any, of the haploid X-chromosome condition and the male response to stress when there is a low or high diploid chromosome number, and extranuclear responses in nonreproducing cells with time, such as possible outer membrane permeability modification. (Abstr.)

See also:

507 Radiation ecology. (Auerbach, S.I., 1967)
1120 Application of radioactive isotopes to the investigation of methods for the biological control of pests. IV. The effects of γ-radiation on C. capitata when the dose of irradiation is fractionated. (Arroyo, M. et al., 1965)
1141 Laboratory studies to sterilize the boll weevil with radiation. (Mayer, M.S. et al., 1966)
1149 Radiation sterilization of sugar-cane leafhoppers of the family Delphacidae. (Shipp, E. et al., 1966)
1195 Studies on the experimental population of Drosophila melanogaster raised on irradiated banana diet. (Hossain, M.M. et al., 1966)
1196 ibid (1967)
1282 Interactions of oxygen at high pressure and radiation in Drosophila. (Thomas, J.J., Jr. et al., 1966)
1302 Effects of gamma radiation on fertility, mating, and longevity of males of the oriental fruit moth, Grapholitha molesta (Lepidoptera: Tortricidae). (George, J.A., 1967)
1313 The effects of x-irradiation on the survival of Liponyssus bacoti and on its susceptibility to infection with Litomosoides carinii. (Quraishi, M.A.H. et al., 1966)
1338 Observations on the behaviour of pupae of Hyphantria cunea Drury irradiated with γ-radiation. (Bogyleanu, G., 1965)
1340 Study on the sterilization and radiosensitivity of Chrysomela decemlineata Say by means of radioisotopes. (Cavalloro, R. et al., 1966/67)
1345 Influence of pupal age on sensitivity to radiation. (Ducoff, H.S. et al., 1966)
1346 Changes with age in the radiosensitivity of adult flour beetles. (Ducoff, H.S., 1967)
1347 On the effect of ^{60}Co gamma radiation on the desert locust. (El-Miniawi, S.F. et al., 1964)
1348 Metamorphic and adult longevity modifications due to x-irradiation of pupal flour beetles, Tribolium confusum (Jacquelin duVal). (Erdman, H.E., 1966)
1349 Effects of x-rays on metamorphosis and adult life span of flour beetles. (Erdman, H.E., 1966)
1351 Effects on flour beetles irradiated as pupae. (Erdman, H.E., 1967)
1356 The effect of gamma irradiation on the Varo race of Bombyx mori L. II. Irradiation of eggs in the early and late embryonic stages. (Gubicza, A. et al., 1964)
1358 Susceptibility of various stages of Drosophila melanogaster to gamma radiation. (Henneberry, T.J., 1967)
1380 x-Irradiation and wing retention in the common house fly, Musca domestica L. (Rockstein, M. et al., 1966)
1381 Further studies on the effect of x-irradiation on the house fly, Musca domestica L. (Rockstein, M. et al., 1967)
1388 Récentes expériences de radiobiologie sur Bombyx mori. (Teulade, P., 1966)
1436 Study of the irradiation tolerance of some destructive storehouse insects and technical and economic aspects of insect destruction by irradiation. (Farkas, J., 1965)
1454 Absence of "oxygen after-effects" in Calandra granaria during hibernation induced with low temperature. (Bychkovskaya, I.B. et al., 1965)
1456 The combined effects of irradiation, vibration, and centrifugation on braconid fecundity, fertility and life span. (Grosch, D.S., 1966)
1457 Utilization of Habrobracon and Artemia as experimental materials in bioastronautic studies. Status Report, Jan. - June 1965. (Grosch, D.S., 1965)
1459 Effect of exposure of irradiated pupae of the Mediterranean fruit fly, C. capitata, to high temperatures. (Katiyar, K.P. et al., 1967)
1461 Influence of post-treatment humidity on the irradiated rice weevil adult, Sitophilus zeamais Motschulsky (Coleoptera: Curculionidae). (Kumagai, M., 1967)
1479 The effects of gamma radiation on the biology and behaviour of adult Ips confusus (leConte) (Coleoptera: Scolytidae). (Wood, D.L. et al., 1966)
1487 Changes in quantitative traits of Tribolium under irradiation and selection. (Bartlett, A.C. et al., 1966)
1499 Effects of radiation induced mutations on viability coefficients in Drosophila. (Falk, R., 1966)
1500 Fitness of heterozygotes for irradiated chromosomes in Drosophila. (Falk, R., 1967)
1514 An estimate of the effects of fallout beta radiation on insects and associated invertebrates. (Teresi, J.D. et al., 1966)

1520 Evolution of fitness. III. Improvement of fitness in irradiated populations of Drosophila serrata. (Ayala, F.J., 1967)

1583 Studies on the eradication of Anopheles pharoensis Theobald by the sterile-male technique using cobalt-60. I. Biological effects of gamma radiation on the different developmental stages. (Abdel-Malek, A.A. et al., 1966)

1584 Studies on the eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. III. Determination of the sterile dose and its biological effects on different characters related to "fitness" components. (Abdel-Malek, A.A. et al., 1967)

1593 Control of fruit flies Dacus zonatus Saunders by gamma-rays. (Huque, H. et al., 1967)

1608 Study of the biology, breeding and sterilisation of the cabbage fly, Phorbia brassicae Bouché, with special reference to its occurrence in radish cultures. (Riedel, M., 1967)

1618 Prospective use of radiation to control the hollyhock seed moth (Lepidoptera, Gelechiidae). (Azaryan, G.K. et al., 1965)

1620 Codling moth control. (Madsen, H.F. et al., 1967)

1657 Status of irradiation control of insects in grain. (Cotnwell, P.B., 1968)

1662 Radiation disinfestation of grain and seeds. (Golumbic, C. et al., 1966)

1666 The Israel food irradiation programme and progress during 1964-1966. (Kahan, R.S. et al., 1966)

1668 Food irradiation research and pilot facilities in operation or planned in India. (Kumta, U.S. et al., 1966)

1699 Effects of gamma irradiation on the longevity and fertility of five species of stored-product insects. (Watters, F.L., 1966)

2.2.7. Lethal Effects

1426 Abdul Matin, A.S.M. SUSCEPTIBILITY OF ADULT RICE WEEVIL, Sitophilus oryzae (L.), TO GAMMA RADIATION. AECD/AG/15, Atomic Energy Centre, Dacca (Pakistan Agriculture Div.). Jan. 1966, 7p.

Weevils were exposed to dose from 5-100 kR. Within one week of irradiation, 100 kR and 90 kR produced mortalities of 100% and 95.2%, respectively, against only 4.8% for 5 kR. - LD 100/24 d was obtained with 10 kR and 15 kR. All doses > 5 kR produced 100% mortality within one month.

1427 Abdul Matin, A.S.M. SUSCEPTIBILITY OF ADULT RICE WEEVIL, Sitophilus oryzae (L.) TO GAMMA RADIATION. p. 133-135 of "Proceedings of the Agricultural Symposium. Dacca, Pakistan, 1966".

For abstract, see 1426.

1428 Bhuiya, A.D., Abdul Matin, A.S.M. THE SUSCEPTIBILITY OF THE RED FLOUR BEETLE, Tribolium castaneum (Hbst.) TO GAMMA RADIATION. AECD/AG/20, Atomic Energy Centre, Dacca (Pakistan). Mar. 1967, 11p.

The susceptibility of all developmental stages of T. castaneum was investigated. Almost complete kill was obtained as follows: for eggs with 9000 R, larvae 8000 R, pupae 20 000 R, and adults 25 000 R. A dose of 20 000 R may be considered the minimum effective dose for controlling T. castaneum, which still allows 8% survival of the sterilized adults.

1429 Bolukbasi, E.K. EFFECT OF TRITIATED THYMIDINE AND IRRADIATION ON THE MORTALITY OF ADULT Drosophila melanogaster LARVAE. CNAEM-32, Cekmece Nuclear Research Center, Istanbul (Turkey). 1965, 20p. (In English)

Several factors that might affect the increase in the mortality rate of adult D. melanogaster larvae when exposed to ionizing radiations have been studied. The application of tritiated thymidine and γ irradiation at different times to the same larvae caused a high but an additive mortality effect. The application of both irradiating agents to the larvae simultaneously caused a higher mortality rate which was even more than an additive one. An irradiated, tritiated thymidine-containing nutrient was found to be harmful for the larvae and seemed to be responsible for the increase in mortality level when both factors were applied to the larvae simultaneously. (CA 66: 1967, 73021e)

1430 Boontiam Disyam. RADIATION EFFECT ON RED FLOUR BEETLE (Tribolium castaneum Hbst.). p. 35-41 of "Insect Eradication by Irradiation, Bangkok, Thailand. 28-29 Jun. 1966". THAI. AEC-8, Office of Atomic Energy for Peace, Bangkok (Thailand).

For eggs, LD 50 is ~1530 rad, LD 100/10 ~ 7500 rad; for larvae, ~2200 and 10 000 rad, respectively; for pupae, ~6200 and 30 000 rad, respectively. Dosages < 10 000 rad prolonged the pupal stage by 2 weeks. For adults, LD 50 ~62 000 rad, LD 100/10 80 000 rad. Sterility was induced in males and females by 6000 rad, but further study is required.

1431 Bushland, R.C. RADIATION STERILIZATION OF THE BLACK BLOW FLY. Bull. ent. Soc. Am. 12 (1966) 289. Abstr. 272. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

Pupae of Phormia regina (Meigen) were irradiated with x-rays and γ-rays to establish sterilizing and lethal doses of radiation. Normal females mated with sterile males would not mate a second time. In cage tests, sterile males competed for mates about equally with normal males. (Abstr.)

1432 Bychkovskaya, I.B. DYNAMICS OF LETHAL RADIATION EFFECTS IN VARIOUS BIOLOGICAL SPECIES. Radiobiologiya 6 (1966) 39-45. (In Russian)

A literature survey was made on the dynamics of radio-induced death of animals, with emphasis on the principles of radiation injury leading to the death of man and monkeys. Data are also included on the life expectancy of rodents, insects, crustaceans, and infusoria after exposure to various doses of α, β, γ, or x-radiation.

1433 Bychkovskaya, I.B., Ochinskaya, G.K. ON THE SYSTEM OF THE RESPONSE OF BIOLOGICAL OBJECTS TO IRRADIATION (EXPERIMENTS ON GRANARY WEEVILS). Zool. Zh. 45, 1 (1966) 134-137. (In Russian)

In tests in the Soviet Union in which adults of Sitophilus (Calandra) granarius (L.) were exposed to x-rays at doses of 0.84-126 kR, the curve for mortality in 50 d was S-shaped, with little mortality at up to 2.95 kR, 20% at 3.35 kR, 80% at 5 kR, 98% at 5.89 kR and 100% at 6.7 kR and higher. When time to 50% mortality was considered, there was a stepwise effect, the periods being about 20 d for 4.2-29.5 kR, 13 d at 34-57.5 kR, and 9 d at higher doses up to 62.5 kR and beyond. Different doses perhaps damage vital systems of different radiosensitivity. (RAE-A 56: 1968, ref. 243)

1434 Ducoff, H.S., Bosma, G.C. ACUTE LETHALITY AFTER x-IRRADIATION OF Tribolium confusum ADULTS. Entomologia exp. appl. 10, 2 (1967) 153-165.

Recently emerged adults of T. confusum, maintained at 30°C in flour-yeast medium, were exposed to x-ray doses between 8 and 75 kR at dose rates of 225 or 1000 R/min. In all cases, there was no significant mortality for about 10 d, and all deaths attributable to the irradiation occurred during the next 10 - 15 d; after the lower doses, many insects survived this critical period and then lived on for many months. The relative dose-independence of the survival-time of decedents suggested that there is a specific mode of death, e.g., an as-yet-unrecognized acute lethal syndrome. Irradiated beetles incubated at 22°C exhibited about twice as great a delay in the onset of mortality, and a mortality period with about twice the duration, as those at 30°C, suggesting the necessity of a sequence of metabolic events in the development of lethality. Beetles on a cornstarch diet were at least as radioresistant as beetles on flour yeast; beetles at 22°C were distinctly more sensitive than those kept at 30°C. Older beetles, exposed 4 or 10 months after emergence, showed progressive increases in acute radiosensitivity. Implications of these findings for radiobiological investigations on adult insects are discussed. (Auth.)

1435 Farkas, J. INVESTIGATIONS INTO THE RADIATION RESISTANCE OF Tribolium confusum (Duval) AND Tyrophagus dimidiatus (Hermann). Acta microbiol. hung. 12 (1964) 15-28. (In Hungarian)

The radiosensitivity of flour beetles was examined in the dose range of 3-50 krad. Survival times correlated with 25 and 50% mortality (LT 25 and LT 50) were established as a function of radiation doses. The lethal effect of irradiation abruptly increased between doses 6 and 12 krad, while doses over 12 krad accelerated beetle mortality only to a small degree. To sterilize adults and eggs, radiation doses of 3 - 6 krad were needed. Eggs were highly sensitive to x-rays, but larval resis-

tance was not higher than that of adults. Therefore, products can be completely disinfested by lethal doses established for adults. Also examined was whether the survival of flour beetles is affected by relative humidity during breeding subsequent to radiation applied in doses of 25 krad. Differences of LT 50 values corresponding to different levels of relative humidity were examined by variance analysis and the results thus obtained showed that the mean survival times observed under 30 and 90% relative humidity were significantly shorter than values at 70% relative humidity. Deviations in the mean survival time, however, are practically not important because differences in LT 50 values remained always below 25%. Radiation resistance of mites (T. dimidiatus) was investigated in the dose range of 25 - 300 rad and proved to be higher than that of the beetles, but with doses of 25 - 50 krad the reproduction of mites could also be prevented. (NSA 20: 1966, 24874)

1436 Farkas, J. NÉHÁNY RAKTÁRI KÁRTEVÖ ROVAR ÉS ATKA SUGÁRTÜRÉSÉNEK VIZSGÁLATA ÉS A BESUGÁRZÁSOS ROVARTALANITÁS TECHNIKAI - GAZDASÁGI VONATKOZÁSAI. (Study of the irradiation tolerance of some destructive storehouse insects and technical and economic aspects of insect destruction by irradiation). Élelm. Ipar. 19, 7 (1965) 221-225. (In Hungarian, with Russian, German and English summaries)

Doses between 3 and 300 krad of γ-radiation were used. The species tested included Coleoptera - Alphitobius diaperinus (Panzer) (lesser mealworm) (a, ℓ): Lathridius (Enicmus) minutus L. (a, p, ℓ), the salami pest; Gnathocerus cornutus F. (broad-horned flour beetle) (a, ℓ); Tenebrio molitor L. (yellow mealworm) (ℓ); Tribolium confusum DuVal (a, ℓ): Lepidoptera — Ephestia kühniella Zell. (Mediterranean flour moth) (ℓ); and among Acarina, Acaridae — Tyrophagus longior (Gerv.) (dimidiatus Hermann) (heterogeneous population). - Death from irradiation occurred only after exposure to several hundred krad. Lowering of life span was observed with smaller doses. The lethal effects increase spectacularly between 6 and 12 krad, a dose corresponding to complete sterilisation. Larvae have less radioresistance than adults, and irradiation can inhibit pupation. Enicmus minutus proved the most susceptible species. Adults irradiated at 10 krad died between 10-12 d. - Tests have shown that the dose must be increased 6-10 times if a 50% destruction of insects is to be achieved in 6 instead of 12 d. Larger doses are required with mites (Tyrophagus dimidiatus): 50, 100 and 200 krad caused 50% reduction of the population after 27, 19 and 2½ d, respectively, and development of the mites was arrested by a dose of 50 krad even under favourable environmental conditions. The radiation sources used were either accelerators or radioisotopes with a long half-life. The advantages of irradiation as a method of disinfestation reside in the fact that complete destruction of the insect population can be achieved with the lethal doses, and eggs have proved very sensitive to radiation. No side effects in the food result from irradiation: no changes in the chemical composition have been observed, and no health risks are involved. In the USA, mobile radiation sources have proved very convenient for seasonal use. The method is very economical; the costs decrease from year to year. It is much cheaper than chemical methods of disinfestation.

1437 Farkas, J. INVESTIGATIONS INTO THE RADIATION RESISTANCE OF THE Tribolium confusum (Duval) AND Tyrophagus dimidiatus (Hermann). Acta biol., Szeged. 16 (1966) 207-215. (In Hungarian)

Radioresistance of flour beetles was examined in the dose range 3 - 50 krad. Survival times correlated with 25 and 50% mortality were established as a function of radiation doses. The lethal effect of irradiation increased between the doses 6 and 12 krad abruptly, while doses over 12 krad raised the speed of beetle mortality only to a small degree. To sterilise adults and eggs radiation doses of 3 - 6 krad were needed. Accordingly, insect eggs resistant to eradication by gas are highly sensitive to x-rays. Radiation resistance of larvae is not higher than that of adults either; therefore products can be perfectly disinfested by lethal doses established for adults. It was also examined, whether the survival of flour beetles was affected or not by relative humidity prevailing in after-breeding subsequent to radiation applied in doses of 25 krad. Differences of LT 50 values belonging to different levels of relative humidity were examined by variance analysis and the results thus obtained showed that the mean survival times observed under 30 and 90% relative humidity and corrected with the mortality rate of control populations were significantly shorter than values belonging to 70% relative humidity. Deviations in the mean survival time, however, are practically not important, because differences in LT 50 values remained always below 25%. Radiation resistance of mites was investigated in the dose range of 25 - 300 krad and proved to be higher than that of beetles, but with doses of 25 - 50 krad the reproduction of mites could also be inhibited. (Auth.)

1438 Finsinger, F. X. ABTÖTUNGS- UND MUTATIONSRATEN NACH RÖNTGENBESTRAHLUNG FRISCH ABGELEGTER Drosophila-EIER IN VERSCHIEDENEN SAUERSTOFFKONZENTRATIONEN. (Lethal and mutation rates in newly laid x-irradiated Drosophila eggs at different oxygen concentrations.) Vischr. naturf. Ges. Zürich 109 (1964) 175-195. (In German)

Eggs of D. melanogaster that were 10 - 20 min old were irradiated in N/O mixtures with 1000 R of 50-keV x-rays. The N/O mixtures contained 0, 2, 4, 8, 10, 21, or 100% O). Embryonic mortality, postembryonic mortality, and the rate of recessive sex-linked lethal mutations were studied. The rates of all three effects increased in gas mixtures that contained from 0 - 10% O, but remained almost constant in atmospheres that contained from 10 - 100% O. The increased rates of embryonic mortality and lethal mutations observed in the O atmospheres, which reflected the ratio of the effect after irradiation in air to the effect after irradiation in N, amounted to 2.4. The analogous ratio for postembryonic mortality was lower. It was possible to show that various radiation effects that were induced within the same experiment, in spite of the same dose dependency, the same dependence on the O concentration, and the same ratio of increase due to the O concentration, were not caused by the same primary effects. (NSA 21; 1967, 22706)

1439 Flint, H. M., Bibow, W. R., Lahren, C. K. RADIATION STUDIES WITH THE BOLL WEEVIL: LETHAL EFFECTS ON LARVAE, PUPAE, AND ADULTS; MALE STERILITY AND DOSE FRACTIONATION. J. econ. Ent. 59, 5 (1966) 1249-55.

Larvae, pupae, and adult weevils are very sensitive to x-rays, as measured by adult survival three weeks after irradiation. Adult survival of 50-70% three weeks after treatment was considered the minimum acceptable. Doses of x-rays that met this criterion were 1200 R for last-instar larvae, 2400 R for late-stage pupae, and about 3200 R for adults. In adult weevils, mortality occurred about 7-14 d after irradiation, and the death rate did not increase when doses were increased from about 3200 - 15 000 R. Male weevils were 90 and 99% sterilised by doses of about 7500 and 9000 R, respectively. No sterilised male lived more than three weeks, and no increase in fertility occurred. In a test with mixed populations of adults irradiated with doses of as much as 4800 R, a significant increase in fertility occurred during the three week test period, but 5 d after doses of 4000 or more roentgens, egg production was almost eliminated. No increased survival occurred when 8000 R were administered in four fractions of 2000 R each to adults at intervals between fractions of as much as 48 h. Both the lethal and sterilising effects of x-rays were reduced when weevils in the larval, pupal, and adult stages were sequentially irradiated with various fractionated doses. Dose fractionation is not promising as a means of producing a sterile and viable weevil. (Auth.)

1440 Hossain, M., Hossain, M. M., Rahman, R. LABORATORY REARING AND SUSCEPTIBILITY OF THE CONFUSED FLOUR BEETLE (ADULT) TO GAMMA RADIATION. AECD-RB-6, Atomic Energy Centre, Dacca (Pakistan). Jan. 1967, 12p.

In the course of studying adult susceptibility of Tribolium confusum Duv. the species was mass-reared and its life history studied. Milled flour at 28±2°C and 80±5% R.H. was fed. The duration of each stage in the life cycle was observed; dispersion in growth rate was found to be maximal in the embryonic stage and minimal in the larval stages. Adults of the same age were exposed to doses up to 25 kR to study mortality. 16-25 kR gave an LD 100/13 (d).

1441 Hunter-Jones, P., Haskell, P. T. OBSERVATION ON THE EFFECTS OF γ-RADIATION ON EGGS OF THE DESERT LOCUST, Schistocerca gregaria (Forsk.) Bull. ent. Res. 56, 4 (1966) 725-735.

The following is virtually the authors' summary. It has been suggested that nuclear radiation might be used for locust control, but insufficient knowledge has hitherto been available to decide whether such a measure is feasible. The results of laboratory experiments on the effect of γ-radiation on eggs of S. gregaria (Forsk.) are described. After a single dose of γ-radiation, the resulting mortality among the eggs was correlated with the size of the dose received and the age of the egg at the time of irradiation. The dose required to kill the older eggs was 40 times that required to kill young eggs; thus, a dose of 144 rad caused almost complete inviability among eggs deposited 1-2 d before irradiation, but a dose in excess of 5500 rad was required to kill eggs deposited 11 d earlier. For comparison, the lethal dose of γ-radiation for humans is estimated to be 400-700 rad. When the irradiation dose was applied in three small fractions, with intervals between them, the percentage of eggs killed was less than when the same total dose was given in one exposure. This difference was presumably due to tissue recovery during the inter-radiation periods. The temperature to which the

eggs were exposed during such periods also affected survival, recovery being greater at higher temperatures. The possibility of using γ-radiation to effect control in the egg-fields, the cost of the equipment needed and the hazards involved are discussed. It is concluded that control by this method not only offers no advantage in terms of cost, effectiveness or convenience compared with conventional insecticide treatment but would be impracticable and dangerous to operators and the inhabitants, both humans and domestic animals, of the treated area. It is possible that other control techniques utilising radiation, such as sterile-male release or attractant traps treated with a sterilant, may be useful against certain species of locusts after further work on the development of chemical attractants has been carried out. (RAE-A 54: 1966, ref. 531)

1442 Shim, J. W., Hyun, J. S., Choi, S. Y. THE EFFECTS OF x-RAY IRRADIATION ON THE PUPAL MORTALITY AND HATCHABILITY OF THE RICE STEM BORER. J. nucl. Sci. Korea 7 (1967) 50-55.

1443 Smirnoff, W. A. EFFECT OF GAMMA RADIATION ON THE LARVAE AND THE NUCLEAR-POLYHEDROSIS VIRUS OF THE EASTERN TENT CATERPILLAR, Malacosoma americanum. J. invertebrate Path. 9, 2 (1967) 264-266.

The effects of γ-radiation were studied on larvae with and without the virus, and on the lyophilized polyhedra. A ^{60}Co-source was used. It would appear that (1) irradiation with doses of ≥ 100 000 rad are lethal to 3rd- and 4th-instar larvae; (2) exposure to 2000 000 rad completely inactivates the polyhedra of the nuclear polyhedrosis of Malacosoma; (3) development of the virus seems to be accelerated in larvae exposed to low radiation doses. The need for further study of (3) is stressed.

1444 Srisan Ruangopas. STUDIES ON THE USE OF GAMMA RADIATION IN THE CONTROL OF PEA WEEVIL (Callosobruchus chinensis L.). p. 18-30 of "Insect Eradication by Irradiation, Bangkok, Thailand. 28-29 Jun. 1966". THAI. AEC-8, Office of Atomic Energy for Peace, Bangkok (Thailand).

Gamma radiation retarded development and had lethal and sterilising effects, depending on dose. 99.8% sterility in eggs was observed when both parents had been exposed as late pupae; 1400 rad caused 99.87% sterility in eggs, 2800 rad 100% when both parents had been exposed at the early-adult stage. Exposure at the late-larval, prepupal or pupal stages showed the female to be more susceptible. Lethal doses were as follows: for pupae, LD 100 - 32 000 rad, LD 50 - 6400 rad; prepupae and late larvae, LD 100 - 16 000 rad; 7-d-old eggs, LD 50 - 1240 rad, 5¾ (at 27.5°C) - 1202 rad, 4 d - 620 rad, 2 d - 380 rad, 1 d - 340 rad.

1445 Srisan Ruangopas. A PRELIMINARY STUDY ON THE USE OF GAMMA RADIATION IN THE CONTROL OF CIGARETTE BEETLE (Lasioderma sericorne F.). p. 31-34 of "Insect Eradication by Irradiation, Bangkok, Thailand. 28-29 Jun. 1966". THAI. AEC-8, Office of Atomic Energy for Peace, Bangkok (Thailand).

The radiosensitivity of eggs was studied. A dose of 800 rad caused 14%, 4000 rad 100% mortality in 1-d-old eggs. The life cycle of the beetle was found to be 37 d (approx. 8 d for the egg, 17 d for the larval, 10 d for the pupal, and ~2-4 d for the pre-emergence stage).

1446 Ucer, E. THE MORTALITY EFFECT OF RADIATION ON Drosophila melanogaster LARVAE OF DIFFERENT AGES. Istanb. Üniv. Fen. Fak. Mecm., ser. B. 30 (1965) 171-175.

To investigate the response of Drosophila of different ages, experiments were performed on 3-, 72-, and 96-h-old larvae exposed to 1300 R of γ-irradiation ^{60}Co. The 96-h-old larvae (or prepupae) passed to the pupa stage apparently without being affected by irradiation and became adults. Larvae irradiated when they were 72 h old became pupae which did not show a statistically significant higher mortality rate than the controls. Larvae irradiated when they were 3 h old showed a considerably higher mortality rate until they reached the pupae and the adult stage. The 3-h-old larvae showed the highest mortality rate between 90 and 96 h after they were irradiated. In D. melanogaster larvae, in the post-embryonic stage, mitosis does not occur. The variable degree of sensitivity observed in the same cells of larvae belonging to different ages may be due to changes in the physiologic condition at the different ages. (NSA 22: 1968, 2549)

1447 Vichuda Krithayakiem. PRELIMINARY STUDY ON THE EFFECT OF GAMMA RADIATION IN CONTROLLLING ORIENTAL FRUIT FLY (Dacus dorsalis Hendel) IN BANANA. p. 58-60 of "Insect Eradication by Irradiation, Bangkok, Thailand. 28-29 Jun. 1966". THAI. AEC-8, Office of Atomic Energy for Peace, Bangkok (Thailand).

Oriental fruit fly when raised in ripe bananas at 90°F and natural humidity had an incubation period of 26-48 h, larval and pupal stages of 7-12 and 8-9 d, respectively, and an adult life span of 1-2½ months. Eggs (17-20 h old) were exposed to 3900, 12000, 16000 and 35000 rad which resulted in 27%, 37%, 87% and 100% mortality. High doses killed larvae rapidly. Corresponding values for larvae were 44%, 93% and at 16000 rad 95% in 10 d. Imperfections in the rearing technique caused excessive rises in mortality which must be eliminated in future experiments.

1448 Walker, D. W., Quintana-Muñiz, V. MORTALITY STAGING OF DOMINANT LETHALS INDUCED IN THE SUGARCANE BORER Diatraea saccharalis (F.) (CRAMBIDAE, LEPIDOPTERA). Bull. ent. Soc. Am. 12 (1966) 250. Abstr. 118. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

Embryonic development was followed in normal embryos, unfertilized eggs, and embryos from irradiated sperm (16.8 kR) or unfertilized eggs (12.0 kR). Embryonic deaths due to radiation occurred either early or late in development. Findings are discussed in relation to work with Hymenoptera and Diptera. (Abstr.)

1449 Zakladnoi, G. A. INFLUENCE OF THE GAMMA IRRADIATION DOSE RATE ON THE LIFETIME OF GRANARY WEEVILS. Radiobiologiya 6 (1966) 478-479. (In Russian)

Increasing the dose rate accelerates the death of granary weevils. With increasing irradiation dose from 12 - 50 krad, the difference in the effect of the dose rate is levelled out at the level of 99.9% death of the weevils; however, the total effectiveness is negligibly reduced. (Auth.)

See also:

26 The effect of tymidine-^{3}H on the mortality of Drosophila melanogaster larvae. (Anil, Y. D., 1964)

27 Application of radioactive isotopes to the investigation of methods for the biological control of pests. V. The effects of γ-radiation on pupae of C. capitata previously labelled with ^{32}P. (Arroyo, M. et al., 1965)

532 Radiation profile of a herbivorous insect. (Reichle, D. E., 1966)

979 The sensitivity of undifferentiated and differentiated nuclei following x-irradiation in the early stage of development of the egg of the termite Kalotermes flavicollis Fabr. (Truckenbrodt, W., 1965)

1093 Comparisons of mutagenic and cell-killing effects of radiation in the silkworm. (Nakao, Y. et al., 1965)

1095 Biological studies: genetics. (National Inst. of Radiological Sciences, Chiba (Japan). 1965)

1131 Sterilization of the coffee leaf miner. (Katiyar, K. P., 1967)

1158 Gamma-induced sterility in the sugarcane moth, [Diatraea saccharalis (Fab.) (Lepidoptera: Crambidae)]. (Walker, D. W. et al., 1967)

1247 Radiosensitivity of the granary weevil as a function of temperature. (Zakladnoi, G. A., 1967)

1258 Sterilizing effect of γ-rays and apholate on the Mexican bean beetle, Epilachna varivestis Muls. (Carillo, J. L. et al., 1963/1964)

1301 Modification in productivity and mortality of flour beetle species and strains due to x-rays and the insecticide, DDT. (Erdman, H. E., 1966)

1341 A study on the life history and the effect of radiation on rice weevil (Sitophilus oryzae L.). (Chettachai Baditsing, 1966)

1349 Effects of x-rays on metamorphosis and adult life span of flour beetles. (Erdman, H. E., 1966)

1350 Ontogeny and x-radiation sensitivity of the flour beetle, Tribolium. (Erdman, H. E., 1967)

1359 Radiation susceptibility of various developmental stages of the Mediterranean fruit fly (Ceratitis capitata Wied.). (Kahan, R. S. et al., 1965)

1365 Cobalt-60 radiation studies with the European chafer. (Lippold, P. C. et al., 1966)

1368 Studies on strain differences in radiosensitivity in the silkworm. I. Screening of sensitive and resistant strains to embryonic radiation killing. (Murakami, A. et al., 1966)

1369 Studies on strain differences in radiosensitivity in the silkworm. II. Relation between sensitivity to embryonic killing and mutability. (Murakami, A. et al., 1966)

1373 The effects of gamma radiation upon various stages of Fannia canicularis (L.). (Nelson, T.E., 1966)

1380 x-Irradiation and wing retention in the common house fly, Musca domestica L. (Rockstein, M. et al , 1966)

1381 Further studies on the effect of x-irradiation on the house fly, Musca domestica L. (Rockstein, M. et al., 1967)

1382 Effects of x-irradiation on postembryonic development of Sarcophaga peregrina Robineau-Desvoisy. (Sasaki, S., 1966)

1384 Cytological study of embryo development in Drosophila melanogaster, following x-irradiation at early developmental stages. (Schneider-Minder, A., 1966)

1390 Effect of gamma radiation on Trogoderma glabrum and Attagenus piceus. (Tilton, E.W. et al., 1966)

1392 The effect of ionizing radiation upon the development of the mallow moth. (Vasilyan, V.V., 1961)

1395 Studies on the radiosensitivity of early embryonic stages of Drosophila melanogaster. (Würgler, F.E., 1964)

1405 Kinetics of aging as revealed by x-ray-dose-lethality relations in Drosophila. (Baxter, R.C. et al., 1967)

1406 Age of death in Drosophila following sublethal exposure to gamma radiation. (Baxter, R.C. et al., 1967)

1410 Modification of fitness in species and strains of flour beetles due to x-rays and DDT. (Erdman, H.E., 1966)

1458 Pyrimidines and the x-ray response of Tribolium confusum. (Hogan, G.R., 1966)

1460 Influence of post-treatment humidity on the irradiated rice weevil adult, Sitophilus zeamais Motschulsky (Coleoptera: Curculionidae). (Kumagai, M, 1967)

1610 Studies of eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. II. Induced dominant lethals in the immature stages. (Tantaway, A.O. et al., 1966)

1649 Disinsectization of African dried and smoked fish by means of irradiation. (Boisot, M.H. et al., 1966)

1650 Dosimetry, tolerance, and shelf life extension related to disinfestation of fruits and vegetables by γ-irradiation. (Brewbaker, J.L., 1966)

1670 Control of the Queensland fruit fly by gamma irradiation. (MacFarlane, J.J., 1966)

1686 Gamma irradiation of grain and other reserves for sterilizing and exterminating pests. (Rukavishnikov, B.I., 1964)

1690 Food irradiation in Australia. (Scott, W.J., 1962)

1693 x-Ray irradiation effects on storehouse destructive insects. (Török, G. et al., 1959)

1696 Irradiation of mangoes for control of the mango seed weevil (Sternochetus mangiferae). (Upadhya, M.D. et al., 1966)

1708 Killing silkworm pupae by irradiation. (Beard, R.L. et al., 1966)

1749 Application of an actographic recording method to the study of the effects of irradiation on Calandra granaria larvae. (Pesson, F.P. et al., 1965)

2.2.8. Modifying Factors (Intensity. RBE. LET. Temperature. Synergists. Chemicals including Protective Agents. Environment at Irradiation. Medium. Pathogens. Physical Factors, e.g. Vibration, Acceleration. Etc.)

1450 Akhalaya, Y.G. INFLUENCE OF INCUBATION CONDITIONS ON THE RADIOBIOLOGICAL EFFECTS ON EGGS OF Bombyx SILKWORMS. Soobshch. Akad. Nauk. gruz. SSR 44 (1966) 727-734. (In Georgian)

x-irradiation to 1500 R produced a negative effect on embryonic development of Bombyx (sericaria mori) silk worm eggs. However, the damaging effects were eliminated by changing the incubation conditions which precluded winter laying. The influence of various incubation conditions on radiobiological effects on silk worm eggs is of practical importance. (NSA 21:1967, 20344)

1451 Amer, N.M., Tobias, C.A. ANALYSIS OF THE COMBINED EFFECT OF MAGNETIC FIELDS, TEMPERATURE AND RADIATION ON DEVELOPMENT. Radiat. Res. 25 (1965) 172-173. Abstr. 5. Paper presented at "13th Annual Meeting of the Radiation Research Society. Philadelphia, Pa., USA, 23-26 May 1965".

Since the effect of magnetic fields on radiation induced wing abnormalities in the adults of T. confusum was demonstrated, a systematic study was undertaken to explore the dependence of such effect on the intensity of the applied magnetic field and on temperature. We are finding that the percentage of abnormality decreases with increasing field intensity up to 8 kG, where the effect corresponds to a dose reduction factor of about 2 (T = 38.5°C). At higher fields the magnetic post-irradiation protection decreases again. Moreover, the effect is much more marked at 38.5°C than at 30°C. Magnetic fields afford protection not only against x-rays but also against temperature induced abnormal development. The effects of magnetic fields also are being tested in various post-irradiation oxygen concentrations. At low oxygen partial pressure, the effect is predominantly protection; at high oxygen partial pressure the magnetic field enhances oxygen toxicity. We are finding that morphologically the effect of elevated temperatures and high oxygen tension on development is similar to that observed when the hormone ecdysone is present in reduced amounts; we are therefore testing the hypothesis that radiation, temperature, oxygen and magnetic fields may influence the hormonal regulatory processes. (Abstr.)

1452 Antipov, V.V., Delone, N.L., Parfyonov, G.P., Vystoky, V.G. RESULTS OF BIOLOGICAL EXPERIMENTS CARRIED OUT UNDER CONDITIONS OF FLIGHT IN SHIPS VOSTOK WITH PARTICIPATION OF COSMONAUTS A.G. NIKOLAYEV, P.R. POPOVICH, AND V.F. BYKOVSKY. "COSPAR Symposium. Florence, Italy, May 1964". N66-20043, Academy of Sciences (USSR). Moscow.

Reproduction processes in Drosophila melanogaster and the hereditary structures of Tradescantia paludosa were studied under conditions of cosmic radiation and weightlessness. The following results are reported along with descriptions of experimental procedures and conditions. The speed of laying eggs, and the viability of embryos and larvae were shown to be approximately the same under weightlessness and normal conditions. Several explanations are given for an excess of female issue: it is suggested that the most valid of these is a relative increase in the competitive capability of the female larvae under the experimental conditions. The following apparently non-hereditary anomalies were observed in the offspring: (1) an absence of 1/2 the thorax; (2) a one-sided absence of macrochetes; (3) a decrease and roughening of one eye; and (4) a shortening and incorrect nervation of one wing. It is noted that only 1/2 of the body is affected in each case. (From Sci. and Techn. Aerospace Repts.)

1453 Antipov, V.V., Delone, N.L., Parfyonov, G.P., Vystoky, V.G. RESULTS OF BIOLOGICAL EXPERIMENTS CARRIED OUT UNDER CONDITIONS OF "VOSTOK" FLIGHTS AND WITH THE PARTICIPATION OF COSMONAUTS A.G. NIKOLAYEV, P.R. POPOVICH, AND V.F. BYKOVSKY. Life Sci. Space Res. 3 (1965) 215-229. Also presented at "5th International Space Science Symposium. Florence, Italy, 12-16 May 1964". (See 1452)

The data are presented on a study of the effect of space flight factors, particularly of weightlessness and radiation, on the fertilization, growth and development of Drosophila melanogaster and on the mechanism of heredity in Tradescantia paludosa. Copulation, oviposition and development of Drosophila are shown to be possible under 4-d weightless conditions. A distortion in the sex ratio has been registered in the cultures of flies grown in flight. It is suggested that rearrangements of chromosomes are caused by the action of vibrations and accelerations while distortions in the mechanism of mitosis are mainly related to the weightlessness effect. (From auth.)

1454 Bychkovskaya, I.B., Ochinskaya, G.K. ABSENCE OF "OXYGEN AFTER-EFFECTS" IN Calandra granaria DURING HIBERNATION INDUCED WITH LOW TEMPERATURE. Radiobiologiya 5 (1965) 700-702. (In Russian).

The insects C. granaria were irradiated in special vacuum tubes at x-ray doses of 5, 6, 7, 8, 9, and 10 kR at a temperature of 1 - 5°C. The insects were held at a lowered temperature after irradiation for periods varying from 30 min to 12 d. The oxygen concentration was varied from 20 - 2% during and after irradiation. The survival at 60 d and the average lifetime of the irradiated insects were taken as criteria of radiation damage. On maintaining conditions of hypoxia during and after irra-

diation, a definite protective effect was observed. On creating conditions of hypoxia from the moment that the weevils had been warmed up to room temperature, no protective effect could be observed. Thus, no oxygen aftereffect could be detected by maintaining the weevils at low temperatures. (NSA 20: 1966, 5385)

1455 Erdman, H.E. EFFECTS OF DIMETHYLSULFOXIDE ON PRODUCTIVITY OF x-IRRADIATED FLOUR BEETLES. Biol. Bull. 130 (1966) 157-169. Also published as BNWL-SA-307, Battelle Memorial Inst., Richland, Wash.

Sexually mature virgin female flour beetles, Tribolium castaneum (Herbst), mutant: sooty, were treated with dimethylsulfoxide (DMSO) and x-rayed. Fecundity, fertility, and viability were measured. DMSO gave no radiation protection to female germ cells. Food containing 4.6% DMSO was unpalatable. Photomicrographs of ovarioles showed that sterility resulted because of oosorption. DMSO might be economically important in protecting stored products from insects. (Auth.)

1456 Grosch, D.S. THE COMBINED EFFECTS OF IRRADIATION, VIBRATION, AND CENTRIFUGATION ON BRACONID FECUNDITY, FERTILITY AND LIFE SPAN. p. 99 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun. - 2 Jul. 1966, 263p." Abstr. 390.

Experiments with female Habrobracon show antagonistic rather than synergistic interaction of radiation and two kinds of factors postulated to increase stresses in cell structures. However, a preliminary series of experiments revealed that relatively low rates of centrifugation were necessary to avoid displacement of abdominal organs and provide consistent results. Three separate sets of experiments, two replicas each, featured 20 g for 24 h during which a total of 750 R of γ-rays was delivered from a ^{60}Co source. Egg production for the combined treatment was intermediate between that obtained from centrifugation or irradiation alone. In addition, hatchability was improved over that following radiation alone. Another combination providing egg production and hatchability records exceeding those of radiation alone involved 120 vibrations/sec delivered over a 4-h period subsequent to 2000 R of γ-rays from ^{137}Cs. Furthermore two 1000 R fractions separated by 4 h of vibration were not additive in effect. The vibration alone decreases reproductive performance only slightly. Greater efficiency in recovery mechanisms are suggested because improvement is noted particularly in units which were primitive oogonia at the time of treatment. Neither centrifugation alone or in combination with radiation decreased life span significantly. (Abstr.)

1457 Grosch, D.S. UTILIZATION OF Habrobracon AND Artemia AS EXPERIMENTAL MATERIALS IN BIOASTRONAUTIC STUDIES. Status Report, Jan. - Jun. 1965. N65-28538, North Carolina State Coll., Raleigh. Dept. of Genetics. 1965, 7p.

The combined effects of radiation and gravity forces in excess of 1 g were investigated using the wasp, Habrobracon. A motor designed for long continuous operation fitted with a head machined to hold capsules of wasps was used in this investigation. Centrifugation for a few minutes at a speed providing a force of 1000 g was found too severe for all stages of the braconid life cycle; however, the majority of adults survived 500 g for as long as 24 h. The radiation exposure was conducted with ^{60}Co at a dose rate of 30 R/h to give 720 R for a 24-h exposure. Experiments were made with centrifuged, irradiated, centrifuged and irradiated, and the control. Egg production and hatchability were decreased for the combination exposure of increased gravity and radiation below the records for either radiation or centrifugation alone. Experiments were also made to test the radiation and prototype packages under simulated space flight conditions. These conditions were: simulated flight profile, irradiation, combined effects of profile and radiation, and control. Wasp survival was good except in the 1000 R position where wasps were pulverized during the simulated reentry vibration testing. (Sci. and Techn. Aerospace Repts.)

1458 Hogan, G.R. PYRIMIDINES AND THE x-RAY RESPONSE OF Tribolium confusum. Diss. Abstr. 27, 3 (1966) 947-B.

The radiosensitizing effects of incorporation into DNA of the halogenated pyrimidines, 5-bromouracil or 5-iodouracil, or their nucleosides (BUdR or IUdR) have been demonstrated in a variety of cell types. At relatively low concentrations in the medium, the halogenated antimetabolites exhibit toxicity within one week after hatching of larvae in analogue-containing medium. The toxicity of brominated analogues is less pronounced than that of the iodinated analogues and is slower to develop. Larval lethality attributable to toxicity and the lethality attributable to x-rays are not clearly

separable. The results obtained in this study indicate that the halogenated analogues tested influence lethality in x-irradiated adult Tribolium. Toxicity of the halogenated pyrimidines or halogenated nucleosides is demonstrable three to five weeks following isolation of pupae into analogue-supplemented medium. The brominated analogues are much more toxic to adults than 5-IU or IUdR. Analogue-treated adults exposed to 7 kR, which is sub-lethal for adults in normal medium, die much earlier than those treated with analogue alone or with supra-lethal doses of x-rays alone. Adults isolated as pupae into unsupplemented medium, transferred to analogue-containing ration after three weeks and irradiated immediately before transfer exhibit marked lethality within one week after irradiation. Transfer of adult beetles to normal medium after three weeks or less in the presence of halogenated analogue virtually eliminates lethality attributable to the analogue. x-irradiation at the time of transfer, however, leads to high mortality. The onset of mortality occurs between the 2nd and 3rd week post-irradiation and is similar to that of supra-lethally irradiated adults in normal medium. The effects of BUdR or IUdR on adult x-ray lethality persist one to two weeks after analogue exposure. Insects grown for 12 weeks in medium containing uracil or thymine exhibit the same survival as those reared in unsupplemented medium. Two weeks after 7 kR-irradiation a sharp decline in survival is seen in both uracil- and thymine-treated groups. No such response is observed in purine-treated Tribolium or adults treated with 5-aminouracil, 6-azathymine or 6-azauracil. (DA)

1459 Katiyar, K.P., Ferrer, F. EFECTO DE LA EXPOSICIÓN A ALTAS TEMPERATURAS SOBRE LAS PUPAS IRRADIADAS DE LA MOSCA DE MEDITERRÁNEO, Ceratitis capitata W. (Effect of exposure of irradiated pupae of the Mediterranean fruitfly, C. capitata, to high temperatures.) Turrialba 17, 1 (1967) 31-34. (In Spanish, with English summary)

The following is virtually the English abstract of this account of investigations to ascertain whether high temperatures during transport might have been responsible for the high mortality of adults from irradiated pupae of C. capitata (Wied.) liberated in Costa Rica. Pupae irradiated at 10 kR and normal pupae were kept for 2, 4, 6 and 8 h at temperatures of 25, 30, 40 and 45°C [77, 86, 104 and 113°F] and 60 to 85% r.h. Adult emergence was normal up to 40°C. Exposure to 45°C for 2 h was lethal to irradiated as well as normal pupae. A heat treatment of 40°C for 8 h immediately after irradiation had no latent adverse effect on the length of life of the adults. Irradiated females survived longer than normal females. (RAE-A 55: 1967, ref. 520)

1460 Kumagai, M. INFLUENCE OF POST-TREATMENT HUMIDITY ON THE IRRADIATED RICE WEEVIL ADULT, Sitophilus zeamais Motschulsky (COLEOPTERA: CURCULIONIDAE). Appl. Ent. Zool. 2, 1 (1967) 51-57.

The relative humidity was regulated by Zwölfer's method, using H_2O, NaCl and $Ca(NO_3)_2$ at four different temperatures ranging from 5°C to 35°C. Three different intensities of γ-irradiation from a ^{60}Co-source (100 000, 50 000, and 25 000 R) were used, and their effects examined at individual-level. The survival rate (SR) or the average number of days during which the insect remained alive, within a month of irradiation, were calculated. The number of days corresponding to SR 50 and SR 5 were compared. The data showed that the higher the relative humidity the less the influence of irradiation under any of the temperatures or dosages used; it is suggested that the effect of post-treatment humidity should not be ignored when irradiating the adult weevil.

1461 Deleted.

1462 Rahalkar, G.W., Nair, K.K. INFLUENCE OF DIAPAUSE ON THE RADIOSENSITIVITY OF KHAPRA BEETLE LARVAE. Proc. ent. Soc. Ont. 97 (1966) 126. Paper presented at "103rd Annual Meeting of the Entomological Society of Ontario, Toronto, Ont., Canada, 2-4 Nov. 1966".

Studies were conducted to determine the effects of varying periods of diapause on the radiosensitivity of the Khapra beetle larvae (Trogoderma granarium Everts). There was practically no mortality in the irradiated larvae during diapause but it manifested itself only after the diapause was broken at 38°C. Since the calculated LD 50's for 10, 20 and 30 d of post-irradiation diapause were not significantly different from one another it was also evident that increases in the length of diapause had no significant effect on post diapause survival time. On the other hand pupation seemed to be influenced by the duration of diapause in the irradiated larvae. This effect was best discernible at low doses. The significance of these findings is discussed. (Abstr.)

See also:

1300 x-Radiation and temperature modification of reproductive performance of single-species and mixed-species cultures of Tribolium confusum and Tribolium castaneum. (Erdman, H.E., 1966)

1304 The influence of antibiotics on the fecundity and fertility of irradiated Habrobracon females. (Grosch, D.S., 1961)

1310 Change of oxidative process in insects under the influence of γ-rays. (Kalmykov, P.C., 1965)

1326 Survival of irradiated insect heart fragments following treatment with propyl gallate. (Larsen, W., 1965)

1330 Effect of actinomycin D on the development of the early imaginal eye disks of Drosophila melanogaster. (Perez-Davila, Y. et al., 1967)

1372 Effect on adult emergency of whole and partial x-irradiation of pupae of the housefly, Musca domestica nebulo. (Nair, K.K. et al., 1967)

1388 Récentes expériences de radiobiologie sur Bombyx mori. (Teulade, P., 1966)

1395 Studies on the radiosensitivity of early embryonic stages of Drosophila melanogaster. (Würgler, F.E., 1964)

1405 Kinetics of aging as revealed by x-ray-dose-lethality relations in Drosophila. (Baxter, R.C. et al., 1967)

1406 Age of death in Drosophila following sublethal exposure to gamma radiation. (Baxter, R.C., 1967)

1408 The effects of ionizing radiation on the longevity of ploidy types in the wasp Mormoniella vitripennia. (Clark, A.M. et al., 1967)

2.3. RADIATION EFFECTS ON INSECT POPULATIONS

2.3.1. Behaviour

1463 · Bergeder, H.D., Böning, D. SOFORTWIRKUNGEN VON RÖNTGENSTRAHLEN BEI WIRBELLOSEN TIEREN UND FRÖSCHEN. (Immediate effects of x-rays on invertebrates and frogs.) Biophysik 2, 4 (1965) 239-246. (In German)

The study was aimed at clarifying the extent to which immediate reactions to ionizing radiation can be observed in the animal kingdom, and the existence of a possible correlation between individual radiosensitivity and the level of phylogenetic development. Results are tabulated in terms of orders, classes, and species investigated, group and/or individual reaction to irradiation, reaction period (including moment of first recognizable response), doses, reaction after irradiation, reaction after repeated irradiation, and reaction to partial irradiation. - Reaction ranged from antenna movement (as in Lepisma saccharina), general restiveness (as in Apis mellifica), trembling (as in Tenebrio molitor pupae), sudden twitching (as in Dytiscus marginalis), increase in peristaltic movement (as in Tenebrio molitor larvae and in Drosophila melanogaster), to avoiding action, from moving away (as in Aphidina ovipara), swimming away (Gyrinus natator), jumping away (as the grasshopper Tettigonia viridissima) to obvious escape (as in Formica rufa).

1464 Blaylock, B.G. THE EFFECTS OF IONIZING RADIATION ON INTERSPECIFIC COMPETITION. Paper presented at the "Genetics Society of America, Chicago, Ill., USA, 1-3 Sep. 1966". ORNL-DWG 67-4292.

The effect of acute and chronic radiation on competition was studied in laboratory populations of the sibling species Drosophila melanogaster and D. simulans which are similar both morphologically and genetically. D. simulans was the superior species for 30 weeks in the control populations, but was eliminated by D. melanogaster when the populations were exposed to a chronic dose of 4.8 rad/h. After an acute dose of 2000 rad, D. melanogaster was the superior species for approx. 12 weeks; however, the reverse was true when the populations were exposed to 10 000 rad. D. melanogaster was eliminated by D. simulans by the end of six weeks. The frequency of irradiated D. melanogaster or irradiated D. simulans (2000 rad) decreased rapidly when placed in competition with non-irradiated flies of the opposite species. Under these conditions, irradiated D. melanogaster recovered after six

weeks, but irradiated D. simulans never recovered and was eliminated in one population after 24 weeks. Population size was affected by the exposure to acute and chronic radiation, but most of the populations recovered after six weeks. The populations receiving 10 000 rad were the exceptions; they required 12 weeks to recover. This was attributed to the effects of radiation on the reproductive capabilities of these species. After nine weeks of competition the populations having the largest average size were the ones that received an acute dose of 2000 rad. (Auth.)

1465 Blaylock, B.G. EFFECTS OF IONIZING RADIATION ON INTERSPECIFIC COMPETITION. ORNL-P-3063, Oak Ridge National Lab., Tenn. 1967, 22p. Also presented at "2nd National Symposium on Radioecology, Ann Arbor, Mich., USA".

For abstract, see 1464.

1466 Brower, J.H. BEHAVIORAL CHANGES IN AN ANT COLONY EXPOSED TO CHRONIC GAMMA IRRADIATION. Am. Midl. Nat. 75 (1966) 530-534.

Changes in the behaviour of a colony of ants, Formica integra, were investigated in an area experimentally exposed to chronic γ-radiation at Brookhaven National Laboratory. The habits of the colony changed so that ants were no longer exposed to high radiation levels. The ants constructed a covered runway, 12.5 m long, extending away from the radiation source and used exclusively for travel to and from the nest. The ants also abandoned the habit of appearing on the exposed nest stub and banking it with litter. (Auth.)

1467 Brower, J.H. A POSSIBLE RADIATION AVOIDANCE RESPONSE EXHIBITED BY AN INSECT POPULATION IN NATURE. Naturwissenschaften 54, 2 (1967) 39-40.

The experimental forest was circular, with a 9500 Ci ^{137}Cs at its centre, delivering high intensity γ-radiation for 20 h each day. In 1961, observations were started on an active colony of Formica integra at the base of burned pine stump 18 m due east of the future site for the radiation source. The colony appeared normal and the characteristic behaviour of the species appeared well developed. In 1962, the colony was again observed to be active although now exposed to 10 R/h for 20 h/d. In the spring of 1963 the colony was again found to be active. The nest now had short sunken runways radiating in several directions. In 1964 the ant behaviour seemed unusual. A runway 12.5 m long had been constructed extending from the base of the stump outward at an angle away from the source. This runway was lost at 29 m from the radiation source. At 29 m the exposure level was only 8.3 R/h or ~1/3 of that at the nest. The runway was excavated below the surface of the soil and covered by ground litter for almost its entire length. Ants used this runway exclusively in travel to and from the nest. No ants were found elsewhere. The runway led not only away from the source of radiation but also toward a greater abundance of insect food (to counteract death of vegetation due to radiation). The behavioural change most likely to have been caused by a direct radiation avoidance response was the abandonment of the litter-collecting habit. The complex behavioural pattern of ants makes interpretation as to causal factors for the observed changes speculative.

1468 Brown, G.A. MALE COMPETITIVENESS IN IRRADIATED AND NON-IRRADIATED Acarus siro L. Bull. ent. Soc. Am. 13, 3 (1967) 194. Abstr. 155. Presented at "New York Meeting of the Entomological Society of America, New York, N.Y., USA. 27-30 Nov. 1967".

A study was established to determine if irradiated males of A. siro would compete favourably with non-irradiated males. Males were irradiated and placed in colonies with non-irradiated males in the following ratios: 1:0, 1:1, 1:5, 1:10. Each colony contained 10 non-irradiated females. (Abstr.)

1469 Darenskaya, N.G., Pravdina, G.M. SOME RESULTS OF THE INVESTIGATION OF ANIMAL BEHAVIOUR IN RADIATION FIELDS. p. 64 of "3rd International Congress of Radiation Research, Cortina d'Ampezzo, Italy, 26 Jun.-2 Jul. 1966, 263p." Abstr. 250.

The results of recent several years' studies of animal behaviour in radiation fields carried out with Drosophila melanogaster, fish, mice, rats, guinea pigs, dogs and monkeys are presented. In experiments with vertebrates γ-irradiation was used. In experiments with D. melanogaster the amount of eggs laid on food surfaces both exposed to and free from β-irradiation was determined. All the animals tested were shown to be capable of determining the position of the radiation source. A response to very low radiation doses (about 0.001-2 R) was obtained for the animals. Threshold dose rates causing

avoidance behaviour varied with the species. The discussion of the results is based on the assumption of radiation acting as an unconditioned stimulus. (From Abstr.)

1470 Dyer, K.F. FITNESS AND COMPETITIVE ABILITY IN IRRADIATED POPULATIONS OF Drosophila melanogaster. Mutation Res. 3, 4 (1966) 327-339.

Experiments are described in which a population of flies was given an acute dose of 1500 rad of x-rays every generation and then allowed to compete with a genetically similar but unirradiated population. The accumulation of 2nd chromosome recessive lethal mutations was measured to provide an estimate of the total genetic damage and it was found that >35% of the chromosomes carried these by generation 12. The rate of accumulation was found to agree fairly well with a straightforward theoretical prediction. The competitive ability of the irradiated population as measured by the number of flies emerging appeared to be well maintained and was, by generation 12, only slightly inferior to its unirradiated counterpart. The decline in the number emerging from generation 1 to 12 could largely be accounted for by the genetic deaths due to homozygous recessive lethals. Flies heterozygous for irradiated chromosomes, however, appeared to have a reduced competitive ability. The significance of these different responses to genetic damage in terms of the structure of the gene pool is discussed. (Auth. summary)

1471 Flint, H.M. THE EFFECTS OF GAMMA RADIATION ON MATING COMPETITIVENESS AND FECUNDITY OF Hippelates pusio Loew. J. econ. Ent. 59, 1 (1966) 96-99.

All gnats were treated either as adults 24-36 h after emergence or as pupae ~2 d prior to emergence. In mating tests males sterilised with 5000 R from a ^{60}Co-source were used. H. pusio Loew males which had been sterilised as adults with γ-radiation were found to be fully competitive with untreated males in fertilizing females in laboratory tests. When males were sterilised in the pupal stage, there was a significant reduction in their ability to compete with untreated males. Observations on the testes indicated a significant reduction in the size of testes of males treated in the pupal stage, while testes of males irradiated as adults were similar in size to untreated controls. When females were treated with a sterilising dose as adults, initial oviposition was 1.6-and 2.3-fold greater than untreated females during the 1st and 2nd days of oviposition, respectively. Thereafter the untreated females laid greater numbers of eggs to the end of the test period.

1472 George, J.A. EFFECT OF MATING SEQUENCE ON EGG-HATCH FROM FEMALE Aedes aegypti (L.) MATED WITH IRRADIATED AND NORMAL MALES. Mosquito News 27 (1967) 82-86.

Irradiated males appear to mate as effectively as non-irradiated males. An investigation into the relative competitiveness of spermatozoa from normal males and those from males sterilised by γ-irradiation in the pupal stage indicated no difference. It does appear, however, that though copulation may occur repeatedly, the only effective one is the first. In the experiments, male pupae due to emerge within ~8 h had been exposed to a dose of 8400 R of γ-radiation.

1473 Krebs, A., Benson, B. EFFECTS OF ^{60}Co-GAMMA RADIATION ON NATURAL DIGGING AND TUNNELING BEHAVIOUR OF THE ANT Pogonomyrmex californicus. Naturwissenschaften 53, 5 (1966) 131. (In English)

P. californicus (Buckly) shows regular and reproducible digging and tunneling behaviour. Ants were irradiated in groups of ten, in a commercial ^{60}Co γ cell at a dose rate of 1300 R/min (air). Total doses ranged from 39000 R to 156000 R. Immediately after irradiation the ants were transferred to special tunneling containers and observed for up to 12 d after exposure. The complexity of the tunnel systems and the amounts of sand moved decrease with increase in radiation dose, indicating damage to the ant's working ability and working skill. Daily shadow-graphs of the sand profiles allowed quantitative evaluation of the dose-effect relationship between dose and amounts of sand moved, and gave an idea of the delay in onset of digging activity for the different groups. Alterations in physiological processes in vital organs and systems by high energy radiation, damage to the central nervous system and/or interference with the chemical communication code among social insects, especially pheromone activities, may contribute to the radiation-induced behavioural changes.

1474 Nakagawa, S., Farias, G.J., Steiner, L.F. THE ATTRACTIVENESS OF MALE LURES TO SPERM-DEFICIENT FEMALE MEDITERRANEAN FRUIT FLIES. Bull. ent. Soc. Am. 12 (1966) 250. Abstr. 115. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov.-1 Dec. 1966".

Releases of irradiated and normal females indicate that each responds strongly to trimedlure or medlure in daylight at 75°F or more in the absence or scarcity of males, but only after the virgin females become sexually mature or the older mated females appear deficient in sperm. (Abstr.)

1475 Picton, H.D. THE RESPONSES OF Drosophila melanogaster TO WEAK ELECTROMAGNETIC FIELDS. Thesis. Northwestern Univ., Evanston, Ill. 68p, 1964.

An investigation was made of the orientational responses of D. melanogaster to weak electromagnetic fields. Magnetic, electrostatic and γ-radiation fields with intensities similar to natural fields were used. The findings are based on an analysis of 109 285 individual fly observations accumulated during 2286 replicate runs. The magnetic fields were shown to influence the degree of turning, the variability of the data, the activity, the phototactic responses and the lunar rhythms of response of the flies. Similar findings were made for the electrostatic and γ-radiation fields. The γ-radiation gave the fewest number of significant responses. All of the fields appeared to have a phasing influence on some of the rhythmic lunar month responses. Combinations of fields tended to give responses more similar to those of the controls than did the single factor fields. The modification of the lunar patterns of response by the experimental conditions is discussed in relation to the biological clock problem. Results were compared with those of similar studies on other organisms. (NSA 20:1966, 18410)

1476 Smith, J.C. A STUDY OF THE USES OF IONIZING RADIATION AS STIMULI. Comprehensive Report, September 1961-May 1967. ORO-2903-33, Florida State Univ., Tallahassee. Dept. of Psychology. 31 May 1967, 18p.

Progress is reported on studies on the immediate response of pigeons and rats to x-ray stimulation. x-radiation was used as the conditioned stimulus in classical conditioning experiments. Preliminary results are included from studies on the effects of x-radiation on the behaviour of the Noctuidae moth. A list is included of 31 publications for the period covered by this report. (From NSA 21:1967, 28594)

1477 Tilton, E.W., Burkholder, W.E., Cogburn, R.R. MATING COMPETITION OF GAMMA-IRRADIATED AND NONIRRADIATED MALE Trogoderma glabrum Herbst. J. econ. Ent. 59, 1 (1966) 168-169.

A preliminary study was conducted to evaluate the mating competition offered by γ-irradiated male T. glabrum Herbst. Virgin males were irradiated with 25 000 rad of γ-irradiation from a ^{60}Co source. When an irradiated male and a nonirradiated male were placed with a virgin female, 56% of the females produced viable eggs, as compared with 97% for the females with a nonirradiated male only. (Auth.)

1478 Weisbrot, D.R. COMPETITIVE INTERACTIONS AMONG IRRADIATED STRAINS OF Drosophila melanogaster. Genetics 56, 3 Pt.2 (1967) 596. Presented at the "1967 Meetings of the Genetics Society of America. Stanford, Calif., USA. 31 Aug.-2 Sep. 1967".

Experiments measuring the genetic effects of radiation in Drosophila usually involve comparisons of irradiated and unirradiated sibs, where both segregrate in separate cultures containing a common genotype. For example, on D. melanogaster, the coisogenicity of second chromosomes is accomplished by crosses with the balanced lethal system, Cy L/Pm. In the process, the flies are irradiated and crossed to sibs to produce among other classes, the regenerated Cy L/Pm and wild-type flies homozygous for the 2nd chromosome except for some radiation induced heterozygosity. Comparisons are then made between these two classes in these and in unirradiated cultures. - To distinguish between the effects of the radiation and genotype interactions among the segregating genotypes, the following experiment was performed. Using the above procedure, six strains of D. melanogaster were established; three were coisogenic for 2nd chromosomes, and three were the Cy L/Pm strains used in each 2nd chromosome isolation. These six strains were then divided into a group whose males were irradiated, and an unirradiated control. Four generations after the treatment, the survival of larvae of each strain was tested in pure or homotypic cultures and in mixed cultures, containing the wild-type strain and its corresponding Cy L/Pm where both or neither had been irradiated. (See Weisbrot, Genetics 53:

1966, 427, for methods.) - The results indicate that while irradiation nonsignificantly reduced the viability of each strain in homotypic cultures, it improved the viability of the Cγ L/Pm in mixed cultures. The genotypic interaction among the competitors modified the effects of the radiation. Furthermore, the apparent reduction in fitness of the irradiated wild-type larvae in mixed cultures would tend to lower the overall effects of the radiation on fitness. (Abstr.)

1479 Wood, D.L., Stark, R.W. THE EFFECTS OF GAMMA RADIATION ON THE BIOLOGY AND BEHAVIOR OF ADULT Ips confusus (LeConte) (COLEOPTERA: SCOLYTIDAE). Can. Ent. 98, 1 (1966) 1-10.

Sterilisation of male and female I. confusus exposed to γ-radiation (^{60}Co) as newly emerged adults was almost complete at levels exceeding 7500 R and 10 000 R, respectively. Mating behaviour of males as expressed by sperm transfer was unaffected by dosages up to 60 000 R. The capacity of beetles of either sex to establish galleries was not affected significantly below this dosage, but female gallery pattern was altered above 15 000 R. Longevity was reduced at levels greater than 5000 R. LD 50 for males occurred at 11.5 d at 7500 R and 29 d in the controls. Mortality of progeny resulting from males irradiated at substerilisation levels was higher than in the controls. The dosage to achieve significant population reduction with minimum effect on longevity and other biological activity is estimated to lie between 6000 and 7500 R. These studies indicate that this sterilisation technique may have promise in the control of bark beetles. The necessity for rearing large numbers on artificial media could be circumvented by mass trapping utilizing their natural sex attractant and by mass rearing in cut host material in the laboratory. (Auth.)

See also :

1123 Effectiveness of sterilization of the mallow moth; irradiability at different stages of development, and certain features of mating and egg-laying. (Buginsky, V.I., 1963)
1127 Radiation sterilization studies on the tobacco budworm, Heliothis virescens Fab. (Flint, H.M., 1966)
1153 Some effects of gamma irradiation on the navel orange-worm, Paramyelois transitella (Walker). (Subrahmanyam, U., 1967)
1156 Radiation-induced sterility for population control of the sugarcane borer (Diatraea saccharalis) in Puerto Rico. (Walker, D.W., 1966)
1294 Spermatogenesis in drones following irradiation of the young larvae with different amounts of x-rays. (Bischkopf, R., 1966)
1302 Effects of gamma radiation on fertility, mating and longevity of males of the oriental fruit moth, Grapholitha molesta (Lepidoptera: Tortricidae). (George, J.A., 1967)
1320 Reproductive potential of the sweetpotato weevil after exposure to ionizing radiations. (Walker, J.R., 1966)
1347 On the effect of Co^{60} gamma radiation on the desert locust. (El-Miniawi, S.F., 1964)
1354 Sterilisation de la mouche méditerranéenne des fruits, Ceratitis capitata Wied., par irradiation des pupes aux rayons gamma. (Féron, M., 1966)
1376 Effects of sub-lethal gamma radiation on the biology and behaviour of the Angoumois grain moth, Sitotroga cerealella Olivier. (Qureshi, Z.A., 1966)
1431 Radiation sterilization of the black blow fly. (Bushland, R.C., 1966)
1593 Control of fruit flies Dacus zonatus Saunders by gamma-rays. (Huque, H. et al., 1967)
1608 Study of the biology, breeding and sterilisation of the cabbage fly, Phorbia brassicae Bouché, with special reference to its occurrence in radish cultures. (Riedel, M., 1967)
1611 Studies on the eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. IV. Mating behavior and its frequency in the sterilized mosquitoes. (Tantawy, A.O. et al., 1967)
1612 Studies on the eradication of Anopheles pharoensis by the sterile-male technique using cobalt-60. V. Mating competitiveness in radiosterilized males. (Tantawy, A.O. et al., 1967)
1622 Studies on the application of the sterility in the tick Ornithodoros tholozani. (Galun, R. et al., 1967)
1749 Application of an actographic recording method to the study of the effects of irradiation on Calandra granaria larvae. (Pesson, F.P. et al., 1965)

2.3.2. Population Dynamics

1480 Bileva, D.S. THE EFFECTS OF x-IRRADIATION ON THE NUMBERS AND VIABILITY OF EXPERIMENTAL POPULATIONS OF Drosophila melanogaster. p. 177-187 of "Vliyanie Ionizirovannykh Izluchenii na Nasledstvennost". Dubinin, N.P., Ed. Moscow, Izdatel'stvo Nauka, 1966. (In Russian)

D. melanogaster was irradiated with 500, 1500, 3000, and 5000 R x-radiation and the population dynamics investigated. During the first 17 d, the decrease in numbers and viability varied directly with the dose. From the 27th-45th day, flies irradiated with 500 and 1500 R outdistanced the controls in numbers. At that stage, viability was equalized in the irradited and unirradiated populations in the 2nd and 3rd generations. From the 55th - 144th day, numerical equilibrium was established in all populations; from the 170th - 335th day the populations again differed in numbers, evidently due to temperature variations. On the 434th day the experimental population did not differ from the control in viability. (NSA 22:1968, 21611)

1481 Carfagna, M., De Capoa, A. MAGGIORE AFFOLLAMENTO NUMERICO IN POPOLAZIONI DI Drosophila melanogaster PERIODICAMENTE IRRADIATE ED ALLEVATE IN CONDIZIONI DI FORTE PRESSIONE SELETTIVA. (Larger numerical overcrowding in populations of Drosophila melanogaster peridoically irradiated and bred in conditions of strong selective pressure.) Atti Ass. genet. ital. 7 (1962) 232-238. (In Italian, with English summary). Also presented at "7th Scientific Meeting of the Italian Genetics Association. Parma, Italy, 9-10 Oct. 1961".

Investigations were carried out on 33 generations of D. melanogaster, a laboratory population of which were exposed to chronic x-irradiation (100 and 500 R per generation). The total number of flies were counted regularly at intervals of 14 d, with double testing of the hatchability and fertility at the 300th and 400th day for individual populations. (1) No significant differences were found between the numeric levels of the two populations exposed to the 100 R dose and those of the untreated controls, pooled means for the two series being 1443 ± 50 and 1354 ± 52.2. (2) The increase in crowding of the two populations exposed to the 500-R dose, already noticeable in the 1st experimental series has become very clearcut, pooled means in the first treated series being 1598 ± 49 against 1354 ± 52 for the controls; a difference which is significant at the 0.001 level. (3) In spite of this obvious increase in the adaptivity of the irradiated populations to conditions of strong selective pressure, higher values resulted for the classical parameters of biological fitness in D. melanogaster (% of hatchability and fertility) for the controls. This apparent inconsistency is very probably due to the fact that there may exist physiological characteristics, other than those measured so far, which are of primary importance in determining fitness under the conditions described.

1482 Klimpinya, A.E. USE OF GAMMA RAYS TO REDUCE NUMBERS OF BEET FLIES. Latv. PSR Zinät. Akad. Vest. No. 11 (1966) n.p.

1483 Lewontin, R. C. A STUDY OF MATHEMATICAL MODELS OF MUTATION AND SELECTION IN MULTI-LOCUS SYSTEMS. Three Year Progress Report, December 1, 1964-November 30, 1967. COO-1437-3, Chigago Univ., Ill. Dept. of Zoology. 12p.

Progress is reported on : development of a multi-locus simulator (computer program) for determining gene frequencies; linkage disequilibrium at selected pairs of loci; phenotypic and genotypic means and variances of each kind of locus; synergistic effects of blocks of genes and effects of linkage on gene frequency; use of simulator for studies on multiple heterotic systems; effects of recombination on fitness of populations; development of a quadratic optimum model for determination of equilibrium of genes in quadratic optimum selection; segregation distortion resulting from abnormal gamete production; population dynamics of male-sterile alleles; effects of fluctuating selection in populations of a given size; selection in inbred populations using two-locus polymorphisms in the grasshopper, Moraba scurra; estimation of fitnesses from genotypic frequencies in successive generations; rates of increase of populations of Drosophila; and interaction of genes in determining evolutionary changes in populations. (NSA 22:1968, 7938)

1484 Planel, H., Soleilhavoup, J.P., Giess, M.C., Tixador, R. ACTION DES RADIATIONS IONISANTES NATURELLES SUR LA REPRODUCTION DES METAZOAIRES: RECHERCHES CHEZ Drosophila melanogaster. C. r. hebd. Séanc. Acad. Sci., D 264, 5 (1967) 755-758.

Les élevages ont été disposés à l'intérieur de deux enceintes de mêmes dimensions, en bois et polystyrène pour les élevages témoins, aux parois de plomb épaisses de 10 cm pour les élevages protégés. La protection de D. melanogaster vis-à-vis des radiations ionisantes naturelles provoque une inhibition ou un retard de développement, les populations adultes protégées étant, à la première génération, toujours numériquement inférieures à celle des cultures de contrôle. Cette constatation permet de penser que la notion d'une activité biologique des radiations ionisantes naturelles, déjà démontrée chez des Protozoaires, s'applique également à des organismes plus complexes, pluricellulaires.

1485 Sankaranarayanan, K. INFLUENCE OF SELECTION ON THE VIABILITY OF IRRADIATED EXPERIMENTAL POPULATIONS OF Drosophila melanogaster. Genetics 57, 3 (1967) 687-690.

The histories of four experimental populations, started in 1962, are reviewed. Three had received 120 000 R x-rays in 60, 30, and 20 generations, respectively, at rates of 2000, 4000 and 6000 R/per generation. Cage populations were developed from three populations with past radiation histories (See III - 926, 942, 944 and IV - 1510) and a control population, which were maintained under conditions designed to minimize larval crowding. The egg-to-adult viability remained at plateau levels of between 60 and 77% (far below that of the control) for periods ranging from 31-54 generations in the different parent populations. Under cage conditions, the viability in all the populations increased to > 90-95% of the control value in about two generations, and later on these were almost indistinguishable from the control level. It is suggested that the rapid rise in viability is a consequence of intense selection prevailing under cage conditions. Presumably mutants that were unfavorable in the new environment were eliminated rapidly and those that were favorable were retained and multiplied.

1486 Willard, W.K. LONG-TERM EFFECTS OF ACUTE LOW-LEVEL x-RAYS ON THE POPULATION DYNAMICS OF THE YELLOW FEVER MOSQUITO, Aedes aegypti.* Hlth Phys. 11, 12 (1965) 1577-1583.

Populations of four life-history stages (eggs, 1st-instar larvae, pupae and adults) of the yellow fever mosquito were subjected to acute low-level x-rays and followed through three generations. Fecundity, egg viability, larval growth rate and mean longevity were population parameters utilised in evaluating the long term effects. Effects were most strongly exerted in the 1st generation and gradually subsided in subsequent generations. Doses of 50-400 R were bound to be stimulatory in some cases, while doses of 800 R and above were detrimental. The egg stage was found to be most sensitive followed by the larval, pupal and adult stages. Effects on egg viability were most drastic and persisted through three generations. (Auth.)

* See also ref. III/927, for thesis of the same title.

See also :

1300 x-Radiation and temperature modification of reproductive performance of single-species and mixed-species cultures of Tribolium confusum and Tribolium castaneum. (Erdman, H.E., 1966)

1490 Studies of the genetic processes in irradiated populations. Dynamics of enumeration of irradiated populations. (Bileva, D.S., 1965)

1491 A study of the genetic processes in irradiated populations of Drosophila melanogaster. III. The fecundity and the concentration of lethal mutations. (Bileva, D.S., 1967)

1496 Genetic variability induced by ionizing radiations in quantitative traits of Habrobracon. (Dalebroux, M.A., 1966)

1497 Progress report (on genetic studies), June 1, 1965 - June 1, 1966. (Dobzhansky, T., 1965/1966)

1522 Les hétéroptères de regan (Hemiptera, Heteroptera). (Dispons, P., 1964)

1530 An aphid population explosion induced by chronic gamma irradiation of a forest. (Woodwell, G.M. et al., 1967)

1579 Mating behavior and population dynamics of the boll weevil as related to the sterile-male-technique of insect control. (Gilliland, F.R. Jr., 1967)

2.3.3. Physiological Characteristics

1487 Bartlett, A.C., Bell, A.E., Anderson, V.L. CHANGES IN QUANTITATIVE TRAITS OF Tribolium UNDER IRRADIATION AND SELECTION. Genetics 54 (1966) 699-713.

The consequences of various combinations of selection (high and random) and levels of x-irradiation (0, 100, and 1000 R per generation) on pupal weight were investigated in two strains of T. castaneum for 11 generations. Reproductive fitness was measured each generation in terms of sterility, adult mortality and number of offspring. The Foundation Strain was an unselected panmictic population with an initial weight of 2.10 mg. The second strain, Large, had originated earlier from Foundation and had been selected for large pupal weight for 44 generations. At the beginning of the present study its average pupal weight was 5.66 mg. - High selection contributed to significant responses in pupal weight, but the degree of response was negatively correlated with the level of irradiation. Even though an increase in heritability and phenotypic variance was observed in some irradiated lines, a decline in reproductive fitness contributed to smaller selection differentials and in turn less selection response. - Several strain interactions were possibly related to the previous selection history of the genetic material. For example, reproductive fitness increased with high selection in Foundation and responded inversely in the Large Strain. Yet the latter was more resistant to the deleterious effects of irradiation than was the Foundation Strain. (Essentially auth. summary)

1488 Dalebroux, M.A., Kojima, K.I. AN ANALYSIS OF RADIATION-INDUCED VARIATION OF BODY-WEIGHT OF Habrobracon juglandis. Genetics 55, 2 (1967) 315-328.

A quantification of the genetic variability induced by γ-irradiation was carried out with quantitative characters of H. juglandis. Adult female (diploid) and male (haploid) body weights were studied in homozygous and heterozygous genetic backgrounds. The dose-response relationship was determined with respect to body weights of females that might be heterozygous for induced mutations. The responses to 0, 1.0, 1.5, 2.5 and 4.0 kR irradiations were measured using the F-ratio between the variances among family means in the irradiated material and in the control. The max. response was obtained at 1.5 kR. Induced genetic variability was studied in detail with 1.5 kR irradiation. (1) A striking increase of genetic variance was observed for induced-mutation-heterozygote females in either homozygous or heterozygous genetic background. (2) A great increase of genetic variance was also observed among males segregating for induced mutations in an otherwise homozygous line (i.e. males produced by mutation-heterozygote females with the homozygous genetic background). However, there was no significant increase of genetic variance among males produced by mutation-heterozygote females with the heterozygous genetic background. - These findings suggest that (a) induced mutations can increase or decrease body weight, (b) induced mutations affecting body weight are not necessarily recessive to their wild-type alleles, and (c) there are little or no nonallelic interactions between induced mutations and the rest of the genes affecting body weight. (Auth. summary)

See also:

1404 Evolution of fitness. I. Improvement in the productivity and size of irradiated populations of Drosophila serrata and Drosophila birchii. (Ayala, F.S., 1966)

1470 Fitness and competitive ability in irradiated populations of Drosphila melanogaster. (Dyer, K.F., 1966)

1496 Genetic variability induced by ionizing radiations in quantitative traits of Habrobracon. (Dalebroux, M.A., 1966)

1497 Progress report (on genetic studies), June 1, 1965 - June 1, 1966. (Dobzhansky, T., 1965/1966)

1511 Investigations on mutability of polygenes and on utilization of induced genetic variability. Summary of the results up to June 30, 1963. (Scossiroli, R.E., 1963)

1520 Evolution of fitness. III. Improvement of fitness in irradiated populations of Drosophila serrata. (Ayala, F.J., 1967)

2.3.4. Genetic Changes

1489 Aastveit, K. INDUCED MUTATIONS IN POLYGENIC SYSTEMS. Hereditas 56, 1 (1966) 20-26.

A highly inbred line of Drosophila melanogaster, which showed no response to selection for high and low sternoplural chaetae number, was irradiated with 1500 R of x-rays or treated with repeated low doses of ethyl methane sulphonate (EMS). The induced genetic variation was measured by the response of the populations to 2-way selection. In the γ-ray experiment a clear response was obtained, in a negative as well as in a positive direction. In the EMS-treated lines no response to selection was obtained in the line selected for high number of sternoplurals. In the low line there was a clear and significant response. (Auth. summary)

1490 Bileva, D.S. STUDIES OF THE GENETIC PROCESSES IN IRRADIATED POPULATIONS. DYNAMICS OF ENUMERATION OF IRRADIATED POPULATIONS. Dokl. Acad. Sci. U.S.S.R., Biol. Sci. sections 164, 1-6 (1965) 597-599 (In English). Originally appeared in Dokl. Akad. Nauk SSSR 164, 1 (1965) 191. (In Russian). Cited as III/915.

The present article is the first in a series of studies of genetic processes which occur in irradiated populations, and is devoted to the analysis of the dynamics of population density following irradiation with different x-ray doses. Density is a convenient criterion for overall evaluation of radiation effects on populations and for establishing dose dependence. The original groups on Drosophila melanogaster consisted of 50 females and 50 males from an inbred line, established from wild flies. Doses of 500, 1500, 3000, and 5000 R were used, each of the five experimental series being repeated three times. During most of the experiment the population was kept at room temperature (24-26°C). During the first generation, density increase was depressed in irradiated populations approximately in accordance with radiation dose. Some population densities approached and some even surpassed the densities of controls between the 2nd and 3rd generations, after which statistically similar equilibrium conditions were established for all populations. The initial drop in density of the irradiated populations was evidently related to mutations induced by irradiation, which lowered the fertility and viability of the flies and were rapidly eliminated under conditions of intensive selection.

1491 Bileva, D.S. A STUDY OF THE GENETIC PROCESSES IN IRRADIATED POPULATIONS OF Drosophila melanogaster. III. THE FECUNDITY AND THE CONCENTRATION OF LETHAL MUTATIONS. Genetika No. 4 (1967) 66-73. (In Russian)

A study of the effect of irradiation and population density on the fecundity (egg production/female/d) of fruit flies (D. melanogaster) from the control and experimental populations was carried out. It was shown by this study that the effect of the density of population 30 × 30 and 50 × 50 reduces the fecundity not less considerably than the irradiation by dosages of 3000 R - 5000 R. The fecundity is determined virtually by that factor which limits it to a greater extent. At the population density 1 × 1 it is the irradiation. As the population density increases by 30-50 times, it is to a greater degree the shortage of food consumed per female. Consequently the difference in the fecundity between the control and irradiated flies decreases with the increase of the population density. In the 1st generation of the progeny of irradiated flies the normal fecundity is completely recovered. It was shown by the investigation of the concentration of lethal and semilethal mutations in the control population and in that irradiated once (at a dosage of 5000 R) before and after the establishment of the equilibrium of the numbers of individuals, that in the control population it was low (10.67%) because this population was derived from an inbred line. In F_3 following the irradiation the concentration of lethals and semilethals increased up to 30.4%. However, after the equilibrium of the population was restored, the concentration decreased again to the level of the control population. (NSA 21:1967, 28421)

1492 Blaylock, B.G. CHROMOSOMAL POLYMORPHISM IN IRRADIATED NATURAL POPULATIONS OF Chironomus. Genetics 53 (1966) 131-136. Also appeared in report form, as ORNL-P-1560, Oak Ridge National Lab., Tenn.

Chromosomal polymorphism in a natural population of Chironomus tentans inhabiting a stream contaminated by radioactive waste was compared with a nonirradiated population. Ten inversions and one deletion were found in the irradiated population but not in the control population. The frequencies of three endemic inversions which were found in both populations were not significantly

different in the irradiated and nonirradiated populations. It was concluded that in the irradiated population, where an increased frequency of new chromosome aberrations was detected, the frequencies of the endemic inversions were unchanged by the chronic radiation. (Auth)

1493 Blaylock, B.G. CYTOGENETIC STUDY OF A NATURAL POPULATION OF CHIRONOMIDAE INHABITING AN AREA CONTAMINATED BY RADIOACTIVE WASTE. p.835-846 of "Symposium for the Disposal of Radioactive Waste into Sea, Oceans, and Surface Water. Vienna, Austria, 17 May 1966". Vienna, International Atomic Energy Agency, Austria. 1966, 898p.

The aquatic larvae of Chironomus tentans, one of the midges, inhabit the radioactive bottom sediments of White Oak Lake and White Oak Creek in large numbers. This aquatic habitat has received varying quantities of radioactive waste released from the Oak Ridge National Laboratory since 1943. Dosimetric measurements and calculations based on radionuclide content of the bottom sediments indicate that these larvae were receiving 230 rad/yr. It is estimated that 130 generations have been exposed to this or greater dose rates for the past 22 years. During the past five years the incidence of chromosomal aberrations in the salivary gland chromosomes of larvae collected seasonally from the radioactive and control habitats was measured. Chromosomal polymorphism is prevalent in C. tentans in this locality and six endemic inversion heterozygotes were found in all populations. Three of these inversions occurred at relatively high frequencies (.09 to .22), but these frequencies did not fluctuate seasonally nor change significantly in the irradiated populations for five years. Also, the frequencies of endemic inversions in the irradiated populations were not significantly different from control populations. In addition to the six endemic inversions found in all populations, ten inversions and one deletion were observed only one time in 755 larvae from the radioactive habitat, while no additional aberrations were observed in 714 larvae from the control habitats. It is concluded that the ionizing radiation from the radioactive waste was increasing the frequency of new chromosomal aberrations in the White Oak Lake and White Oak Creek populations, but these new aberrations were eliminated by selection. Also this level of chronic radiation, which was capable of producing a detectable increase of new chromosomal aberrations, has not affected the fitness of the population by producing a change in the frequencies of the endemic inversions. (Auth.)

1494 Blaylock, B.G. POPULATION GENETICS AND RADIATION EFFECTS STUDIES. p.48-50 of "Health Physics Division Annual Progress Report for Period ending July 31, 1966". ORNL-4007, Oak Ridge National Lab., Tenn. Oct. 1966, 300p.

Study of the natural population of Chironomus tentans in White Oak Lake and White Oak Creek has continued since 1960. Annual samples were taken from this population, which has been exposed to an estimated dose of 230 rad/yr for > 120 generations; 12 different aberrations were found in the irradiated population (at a very low frequency). One aberration, a small inversion, was found in larvae of an irradiated population of C. plumosus. Ionizing radiation from the contaminated environment evidently increases the frequency of new chromosomal aberrations, which are, however, rapidly eliminated by natural selection. Laboratory populations of Drosophila melanogaster, D. tropicalis, and D. simulans were used to study the effects of γ-radiation in interspecific competition. Laboratory D. melanogaster established for chromosomal polymorphism studies were also used to study viability (egg to adult emergence) of the population after exposure to acute (2000 rad) and chronic (6 rad/h) γ-radiation. Viability was reduced by 80% but recovered rapidly after acute irradiation, whereas chronic irradiation resulted in a slow reduction, and was never as great.

1495 Buzzati-Traverso, A.A. VELOCITA' DI PROCESSI MICROEVOLUTIVI IN POPOLAZIONI IRRADIATE. (Velocity of microevolutionary processes in irradiated populations.) Atti Ass. genet. ital. 5 (1960) 183-184. (In Italian, with English summary). Also presented at "5th Scientific Meeting of the Italian Genetic Association and the 8th Annual Meeting of the Biometric Society. Naples, Italy, 22-24 Oct. 1959".

Previous experiments have shown that the rate of microevolutionary processes leading to higher fitness is higher in Drosophila melanogaster populations treated with x-rays than in non-irradiated control populations. Physiological traits, such as fecundity, as well as morphological traits controlled by polygenic systems were shown to undergo evolutionary change. Populations are currently under study in which the mutant spineless (ss) of the III chromosome is used as a marker in combination with other recessive mutants. In a relatively large number of such populations (2 out of 6 in

one set, and 7 out of 16 in another) individuals have appeared whose bristles are appreciably longer than those of the ss mutant. Since their 1st appearance in any one population the percentage of such non-spineless individuals has steadily increased, thus showing that they possess positive selective value. This trait is due to different sets of polygenes in each population. A comparison between irradiated and non-irradiated populations shows that the rate of occurrence of such polygenic mutants affecting the ss phenotype is markedly different in different populations. Indistinguishable phenotypic changes can thus show different selective values depending on the polygenic systems by which they are controlled. (Auth.)

1496 Dalebroux, M. A. GENETIC VARIABILITY INDUCED BY IONIZING RADIATIONS IN QUANTITATIVE TRAITS OF Habrobracon. Diss. Abstr. 26, 8 (1966) 4182.

The traits studied were adult female body weight, adult male body weight and fecundity. The experimental designs and mating schemes were set up to take max. advantage of the haploidy of the males in this organism. A group of females from an inbred line were irradiated and their parthenogenetic sons were mated individually to virgins from the same as well as from a different inbred line, in order to obtain families with homozygous and heterozygous genetic backgrounds, respectively. The analysis of the data on female body weight and fecundity was done on the basis of the means of the above families. The male body weight character was studied among individual grandsons within families and among family means. Doses 0.0-4.0 kR helped to determine an appropriate dose level at which a significant response in mutation yield could be expected in at least one of the traits under consideration. The dose of 1.5 kR was chosen on the basis of a preliminary investigation, (0.0-4.0 kR doses), and the effects of the radiations in later generations were studied in both homozygous and heterozygous genetic backgrounds. The radiation source used was ^{60}Co delivering γ-rays at the rate of approx. 250 kR/h. From an analysis of family means it appeared that (1) In both genetic backgrounds, a highly significant increase in genetic variation was detected for female body weight. (2) Insofar as fecundity is concerned, there was only a tendency towards increasing the genetic variability in the treated materials as compared to their respective controls. (3) There seemed to be no evidence of nonallelic interactions between induced mutations and their genetic backgrounds. When the analysis was carried out on individual male body weight, the increase in genetic variance induced by radiations was much larger under the homozygous genetic background than that found under the heterozygous background. The reliability of the dosage-response curve was discussed. An interpretation of the lack of any significant response for the fecundity trait was given, particularly on the basis of the dominance relationship between the induced mutant genes and their wild type alleles. Finally, in order to explain the apparent disagreement between the hypothesis of nonepistasis and the results obtained from individual male body weight, a possible explanation was proposed using a genetic model based on the absence of nonallelic interactions. (From DA)

1497 Dobzhansky, T. PROGRESS REPORT (ON GENETIC STUDIES), June 1, 1965 - June 1, 1966, NYO-3096-8, Rockefeller Univ., New York. 13p.

A review of current work and work completed is presented under the headings (1) Genetic loads in irradiated experimental populations, (2) Genetic loads in natural populations, (3) Chromosomal polymorphisms in natural and experimental populations, and (4) Genetic diversity and selection. [(1) is of immediate interest here.] The genetic consequences of exposure to x-radiation are described for experimental populations of Drosophila melanogaster maintained under conditions of relaxed selection. As expected, the egg-to-adult viability increased rapidly after relaxation; however, new and constant viability levels become established, all significantly lower than the control level (~70-75%). Thus, the egg-to-adult mortality in the populations with radiation histories continues, many generations after irradiation has been discontinued, to be 15-20% below the control level. (Competition had been deliberately minimized in the experimental populations.) - Experiments are also reported on irradiated and control populations of D. serrata and D. birchii. It appears that the increased genetic variance induced by the irradiation described may be exploited by natural selection to increase the fitness of the populations, at least under the highly artificial and stringently competitive conditions which had been deliberately created in the experiments.

1498 Dobzhansky, T. PROGRESS REPORT [ON GENETIC LOAD IN NATURAL POPULATION IN RELATION TO GENETIC BACKGROUND], June 1, 1966-June 1, 1967. NYO-3096-21, Rockefeller Univ., New York. 12p.

Radiation effects on the proportion of lethal 2nd chromosomes in Drosophila melanogaster were studied. Genetic loads in irradiated populations of Drosophila were studied. Three of the four populations had received accumulated doses of 120 000 R. Data obtained on continued irradiation would best be fitted by a hypothesis that the frequent lethals are maintained in the populations by heterotic advangages.

1499 Falk, R. EFFECTS OF RADIATION INDUCED MUTATIONS ON VIABILITY COEFFICIENTS IN Drosophila. p.80 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun.-2.Jul. 1966,. 263p". Abstr. 315

Radiation induces a random array of mutations. Most of these mutations are deleterious in homozygotes. Yet, some investigators found the viability of heterozygotes for induced mutations to be higher in some cases than that of the unirradiated controls, especially when the control genotype was homozygous at most loci (Wallace) or was below an optimal heterozygosity level (Mukai). The hypotheses advanced to explain these increases in viability had to assume the existence of non-specific interactions of allele pairs. It was hoped that such hypotheses should explain the origin of variability in natural populations. The mean viability of D. melanogaster heterozygous for chromosomes irradiated in spermatozoa with 2000-3000 R was found to be somewhat less than that of the unirradiated controls. When the experiments were designed so as to eliminate factors that could bias the results, such as differences in competing ability that would compensate for differences in viability, the viability coefficient of heterozygotes for irradiated chromosomes was equal, or even higher than that of the unirradiated controls. In later experiments a significant increase in viability coefficients of flies heterozygous for chromosomes irradiated with 12 000 R in spermatogonia, was observed. Most chromosomes carried one or more mutations that affected the viability of the homozygotes severely. Similar high viability coefficients were observed in other series irradiated with 3000 R and 6000 R in spermatogonia. Since the unirradiated controls were highly heterozygous, irradiation was expected to reduce the viability coefficients, even according to the "optimal heterozygosity" hypothesis of Mukai. Another method of estimating viability yielded lower viability estimates for heterozygotes for irradiated chromosomes than for the unirradiated controls. (Abstr.)

1500 Falk, R. FITNESS OF HETEROZYGOTES FOR IRRADIATED CHROMOSOMES IN Drosophila. Mutation Res. 4, 6 (1967) 805-819.

Artificial populations of D. melanogaster were established in small plastic containers. Each population was started with equal numbers of flies heterozygous for a Curly-chromosome and a given irradiated chromosome and flies heterozygous for the same Curly-chromosome and an unirradiated chromosome. Since the homozygotes were either lethal or sterile, only fitness of the heterozygotes for the irradiated chromosome and of the heterozygotes for the unirradiated chromosome determined the fate of the populations. - In one experiment more than 240 populations were started with chromosomes which had been exposed in spermatozoa to 2000 R. Most populations were maintained for 3-4 months. In the second experiment more than 200 populations were started with chromosomes which had been exposed in spermatogonia to 4 doses of 3000 R each. Most populations were maintained for 7 months, and those not heterozygous for lethals were maintained for another 5 months. A third, control experiment, included only non-irradiated chromosomes. In both radiation experiments the fitness of heterozygotes for irradiated chromosomes was below unity fitness. It did not deviate from unity in the control experiment. The mean fitness of heterozygotes for lethals was reduced by about 7%/generation. Subvitals were defined so that they overlapped the normal range, yet their fitness in heterozygotes was reduced by about 2%/generation. Normal chromosomes in the irradiated samples did not deviate from unity fitness. On the average the fitness of the heterozygotes for a sample of newly induced mutations is correlated to the viability of the homozygotes. This is also demonstrated by the improvement in the viability of the homozygotes for chromosomes, which were originally subvital, after these were exposed for nearly 1 yr to selection as heterozygotes. (From auth. summary)

1501 Hoyer, R. F. SOME NEW MUTANTS OF THE HOUSE FLY, Musca domestica, WITH NOTATIONS OF RELATED PHENOMENA. J. econ. Ent. 59, 1 (1966) 133-137.

Two subcolonies, one from the Orlando Regular and the other from the Tropical "P" strain, had been routinely exposed to γ-radiation (~ 600 R) as pupae in each generation for more than 50 generations. Several mutants of the housefly, M. domestica L., were isolated from normal and γ-irradiated strains reared in the laboratory. The identity and maintenance of mutant strains, along with notations of related phenomena, are presented. Most of the aberrant forms that were isolated involved wing form, wing positioning, or the pattern of wing venation. Four established mutant strains, classic wing, stubby wing, dot vein, and white, have proved useful in the genetic analysis of insecticide resistance.

1502 Jones, L.P. EFFECTS OF x-RAYS ON RESPONSE TO SELECTION FOR A QUANTITATIVE CHARACTER OF Drosophila melanogaster. Genet. Res. 9, 2 (1967) 221-231.

Lines with ten pairs of parents and selected at an intensity of 20% were exposed to 1000 R of x-rays for 0, 2, 10 or 30 generations. Lines which received some irradiation generally gave greater response than the unirradiated controls. The phenotypic variance in the irradiated lines was much higher than in the controls. There was little difference in behaviour between lines receiving ten generations of irradiation and those irradiated every generation. Lines receiving only two generations of irradiation had lower variances than the other irradiated lines, but in one of three replicates the response was greater than the corresponding continuously irradiated line. Lethal frequencies were much higher in irradiated than unirradiated lines. Particular chromosome II and III lethals were at high frequencies in most of the irradiated lines but in only two out of five controls. On relaxation, the mean of the irradiated lines generally declined considerably, but in the unirradiated lines there was only a very small regression. It appears that most of the extra response and increased variance in the irradiated lines were caused by a few genes with large effect on bristle number. (Auth. summary)

1503 Kitagawa, O. THE EFFECTS OF x-RAY IRRADIATION ON SELECTION RESPONSE IN Drosophila melanogaster. Idengaku Zasshi (Jap. J. Genet.) 42 (1967) 121-137.

Experiments were conducted with D. melanogaster for the purpose of investigating the mechanism by which new genetic variability available for artificial selection is induced by x-rays and to estimate the increase in polygenic variability in abdominal bristle numbers. Genetic variability, probably originating from mutation and recombination in polygenic systems, was induced by x-irradiation (1500 R) and contributed to the effectiveness of artificial selection. Selection response based on analysis of variance was greatest when both sexes were treated and in groups where males only were treated. Rates of radioinduced mutations, in terms of increments of variance, were 28.1×10^{-5} for both sexes treated, 10.7×10^{-5} for only females treated, and 20.3×10^{-5} for only males treated. (NSA 21: 1967, 26397)

1504 LaChance, L.E., Hopkins, D.E. EFFECT OF SELECTION ON WHAXY: AN AUTOSOMAL DOMINANT MUTATION IN THE SCREWWORM FLY WITH RECESSIVE LETHAL EFFECTS. Am. Nat. 99 (1965) 47-57.

The mutant Whaxy was originally described as one of several mutants in the screwworm fly, Cochliomyia hominivorax, induced by ^{60}Co γ-radiation. Irradiation of a large number of flies was carried out in connection with a programme of radioinduced sterilisation of males for eradication of this gly. The mutation has now been under selection for more than 30 generations. The mutant flies are viable and their flight or other activity is not affected. In general, the data support the hypothesis that the Whaxy factor is dominant and lethal in the homozygous condition. However, after 22 generations of selection the number of Whaxy progeny in each generation increased significantly and has remained at a higher-than-expected level, assuming that the homozygous state continued to be lethal. Tests were conducted to investigate the possible reasons for the increase in Whaxy progeny. Data are presented on the hatchability of eggs, pupal emergence, and segregation of progeny from different crosses involving Whaxy flies. In the earlier generations crosses of Whaxy flies produced the expected 2 Whaxy : 1 normal progeny, and out-crosses produced the expected 50% Whaxy progeny. To explain the fact that after 22 generations of selection the number of Whaxy progeny in each generation increased significantly above 66% and remained at a level higher than expected, the possibility that selection resulted in a higher viability of the hetero-

zygotes, survival of the homozygotes, or lower viability of the wild type is considered. Data from several experiments supporting one or the other alternatives are presented. The phenotype is due to a dominant autosomal mutation with recessive lethal effects. (NSA 21: 1967, 6476)

1505 Marques, E.K. GENETIC EFFECTS OF GAMMA RADIATION ON Drosophila POPULATIONS UNDER INTERSPECIFIC COMPETITION. p. 149 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy. 26 Jun.-2 Jul. 1966, 263p." Abstr. 590.

The average fitness of Drosophila populations can be measured by the competition between different species. The changes induced in their genetic pool by radiation will be represented by selective advantage or disadvantage measured by the proportional number of offspring of one species compared with the number of another in successive generations. The interspecific competition between D. nebulosa and D. willistoni started with 50% of each species without overlapping generations always results in the elimination of D. willistoni. The speed of elimination in 16 population cages at 25°C (588 032 flies) was modified by the ^{60}Co γ-radiation. After a decrease of the average fitness dependent of the doses accumulated in the D. nebulosa populations (500 R, 1000 R or 2000 R per generation) we obtained an increase in the fitness of the 1st and 2nd group of these irradiated populations. In the control populations between the 8th to the 12th generations D. nebulosa eliminated the other species. At that generation we obtained in the irradiated populations 85.88% (500R/generation), 57.64% (1000R/g) and 1.70% (2000R/g) of D. nebulosa. We started 24 new populations with 50% of D. nebulosa of the 13th generation of the populations above mentioned in competition with D. willistoni from a non-selected stock. The D. nebulosa showed an increase in the competitive ability but maintaining the decrease in the average fitness dependent of the accumulation of doses: $\bar{w}$: Control > 500R/g > 1000R/g. Replications of these same populations when irradiated with 1000R per generation showed a different fitness measured by the speed of elimination of the D. willistoni: w: 500R/g > 1000R/g > Control. Tests of egg mortality (120 383 eggs) and egg-adult viability showed this same relation, clearly suggesting the appearance of radioresistance. (Abstr.)

1506 Matsudaira, Y. ON THE INTERACTION BETWEEN THE CHROMOSOMES CARRYING THE DETRIMENTAL GENES OR GENE BLOCKS IN VIABILITY. J. Radiat. Res., Chiba 4, 2-4 (1965) 111-119. (In English)

This investigation was carried out to clarify whether or not the induced detrimental genes or gene blocks interact with each other, by means of using Drosophila as the material. It was ascertained that an interaction between genes or gene blocks for the viability in the 2nd and 3rd chromosome exists. It was also demonstrated that the spectra of viability, this is, the distribution of frequencies in viability, formed bimodal curves for irradiated 2nd chromosomes, for irradiated 3rd chromosomes, and for both irradiated 2nd and 3rd chromosomes. The spectrum of viability in the isogenic lines is discussed with inference to these results. Further, the genetic load of an organism having two interacting loci is calculated, based on the theoretical model and based on the obtained results. (Auth.)

1507 Mukai, T., Yoshikawa, I., Sano, K. THE GENETIC STRUCTURE OF NATURAL POPULATIONS OF Drosophila melanogaster. IV. HETEROZYGOUS EFFECTS OF RADIATION-INDUCED MUTATIONS OF VIABILITY IN VARIOUS GENETIC BACKGROUNDS. Genetics 53 (1966) 513-527.

Heterozygous effects on viability of induced 2nd chromosome mutations were tested in both homozygous and heterozygous genetic backgrounds (with respect to the 2nd chromosome), in experiments involving approximately 2.8 million flies. The mutations, mainly polygenic, were induced by 500 R x-irradiation administered at a dose rate of approx. 100 R/min. Induced mutations are heterozygously slightly beneficial in an otherwise homozygous genetic background which was directly extracted from an equilibrium natural population, while they are, in heterozygous condition, neutral or at least not heterotic in an otherwise homozygous genetic background which was synthesised using 64 unrelated wild-type stocks. When these induced mutations were placed as heterozygotes in either intra- or inter-population crosses, they seemed to be slightly detrimental. The radiation-induced mutation rate of polygenes controlling viability was estimated to be approx. 0.79 per 2nd chromosome per 500 R. The role of overdominance in the maintenance of genetic variation in random mating equilibrium populations is discussed. (Auth.)

1508 National Inst. of Radiological Sciences, Chiba (Japan). GENETICS. p. 47-55 of Annual Report [on Radiological Sciences]. NIRS-5. Dec. 1966, 84p.

Progress is reported on numerous studies including one on the effects of x-rays on genetic load in a Drosophila population; heterozygous effects of newly arising spontaneous lethal genes on viability in D. melanogaster; effects of toyomycin on x-ray induced recessive lethal mutation rates in D. melanogaster; the effect of chronic radiation on sex-linked lethal mutation frequencies in D. melanogaster.

1509 Salceda, V.M. RECESSIVE LETHALS IN SECOND CHROMOSOMES OF Drosophila melanogaster WITH RADIATION HISTORIES. Genetics 57, 3 (1967) 691-699.

Experimental populations with radiation histories, and a control population, were kept in laboratory population cages under conditions of extreme crowding and intense larval competition. The frequencies of 2nd chromosomes which were lethal or semilethal when homozygous remained at levels appreciably higher than in the control, while the egg-to-adult viability declined below the control level in the populations with radiation histories. The rates of allelism of the lethals in experimental populations are fairly high, owing to some lethal loci being present in many chromosomes. These lethals are maintained in the populations by natural selection because of their heterotic effects in heterozygous individuals. (Auth. summary)

See also 1485.

1510 Sankaranarayanan, K. SOME COMPONENTS OF THE GENETIC LOADS IN IRRADIATED EXPERIMENTAL POPULATIONS OF Drosophila melanogaster. Genetics 54, 1 Pt. 1 (1866) 121-30.

Three experimental populations, kept under conditions designed to minimize the larval competition and crowding, received each 120 000 R of x-rays during 20, 30 and 60 generations, respectively. The egg-to-adult viability decreased sharply, but, after the radiation was discontinued, the egg-to-adult viability recovered rapidly for several generations and then reached a plateau. This plateau is, however, 15-20% below that in the control, unirradiated, population. - The frequencies of the 2nd chromosomes which were lethal or semilethal when homozygous declined after the cessation of the radiation, without however in any case reaching the control level. The frequency of alleles among the lethals has increased. Some particular lethal chromosomes have become more frequent, probably owing to heterotic effects under the conditions obtained in these experiments. (Auth. summary)

1511 Scossiroli, R.E. INVESTIGATIONS ON MUTABILITY OF POLYGENES AND ON UTILIZATION OF INDUCED GENETIC VARIABILITY. Summary of the Results up to June 30, 1963. TID-19432, Pavia Univ. (Italy). Istituto di Genetica. 1 Jul. 1963, 34p.

Results are reported from studies of radioinduced mutations in maize, wheats, tomatoes, and alfalfa. Observations on induced genetic variability for quantitative traits are presented. Data are also included from a genetic analysis of long-and short-winged lines of Habrobracon juglandis after 15 generations of inbreeding. (NSA 17:1963, 38746)

1512 Scossiroli, R.E. INVESTIGATIONS ON MUTABILITY OF POLYGENES. Final Report. NYO-10620, Pavia Univ. (Italy). Instituto di Genetica. 31 Dec. 1963, 13p.

Progress is reported in studies on the effect of spontaneous and induced mutations in the induction of quantitative genetic traits in plants. x-radiation was used as the mutagenic agent when applied to seed or gametes. Data are included from a study on the persistence of genetic variability under prolonged inbreeding in populations of the parasitic wasp, Habrobracon juglandis. A list is included of publications resulting from investigations carried out under this contract.

1513 Sperlich, D. POPULATION GENETICS. PART I. Drosophila. Fortschr. Zool. 18 (1967) 223-278. (In German)

Genetic burdens in certain irradiated Drosophila populations are reviewed. Effects on populations of D. ananassae irradiated by atomic bomb tests were inconclusive. After single irradiation of 70 000 D. willistoni with a high dose and subsequent isolation the lethal factor frequency decreased to normal after five generations, but the allele rate remained high, indicating that single heterotic lethal factors reached an increased frequency. In other studies with this species and with D. subobscura and D. pseudoobscura it was found that the inversion density decreased after irradiation; the adaptive inversion system was disturbed, and the lethal factor frequency returned to normal after

1½ yr. The frequency of irradiated chromosomal types decreased initially and then became normal after irradiation of D. pseudoobscura that had AR and CH chromosomal structural types. In populations of D. melanogaster irradiated once or chronically, the fitness components of egg hatch rate and egg-imago survival rate reached 70-75% of normal after a few generations. At this time the populations contained 60-90% lethal II chromosomes. This lethality was eliminated slowly and incompletely. The egg hatch rate of irradiated D. willistoni did not reach normal value 15 generations after irradiation. After 2½ yr of irradiation with 65 000 R the number of individuals of two populations of D. melanogaster reached the starting value after an initial decrease. Decreased growth capacity was demonstrated in irradiated D. pseudoobscura populations. Radio-induced chromosomal inversions were observed in Chironomus tentans populations. About 25% of irradiated D. melanogaster populations showed chromosomal structural changes, and many translocations were observed after neutron irradiation. It was concluded that general conclusions about the increased mutation rates observed in irradiated populations could not be made. (NSA 22:1968, 8509)

1514 Teresi, J.D., Newcombe, C.L. AN ESTIMATE OF THE EFFECTS OF FALLOUT BETA RADIATION ON INSECTS AND ASSOCIATED INVERTEBRATES. (1) USNRDL-TR-982, Naval Radiological Defense Lab., San Francisco, Calif. 28 Feb. 1966, 86p. (2) AD-633024. 1966, 93p.

Three practical considerations were found to merit attention in the evaluation of the impact of fallout radiation on terrestrial insects and associated invertebrates. First, the relatively low dose levels that will affect developmental stages as compared to adult stages; second, the lower doses required to produce late mortality as compared to those required for early deaths; and third, the relatively low doses that will cause sterility. The calculated potential β-doses indicated that the dose level expected to sterilise a large majority of the organisms considered would be found in areas bounded approx. by the 50 R/h at 1 h γ-contour (4600 β-rad accumulated in about 5 d) for a 1 MT burst, by the 100 R/h at 1 h γ-contour (5200 β-rad in about 5 d) for a 10 MT burst and by the 100 R/h at 1 h contour (5200 β-rad in about 14 d) for a 100 MT burst. (Auth.)

1515 Tobari, I., Nei, M. GENETIC EFFECTS OF x-RAYS ON QUANTITATIVE CHARACTERS IN A HETEROGENOUS POPULATION OF Drosophila melanogaster. II. FURTHER INVESTIGATION. p.66-67 of "Annual Report 1964". NIRS-4, National Inst. of Radiological Sciences, Chiba (Japan). Dec. 1965, 94p.

1000 flies of each sex taken at random from a heterogeneous population were exposed to 1000 R of x-rays at 100 R/min. Three generations after x-irradiation the means and variances of abdominal and sternopleural bristles were examined, and the total phenotypic variance was partitioned into its components by a sib analysis. The tabulated data from two sets of experiments indicate that the genetic component was increased throughout by x-rays whereas the environmental component showed no significant change. This suggests that the increase of phenotypic variance by x-rays is mainly due to the increase of genetic component, as is expected theoretically. The amount of variance increase/R is computed as 10.1×10^{-4} and 5.0×10^{-4} for abdominal and sternopleural bristles, respectively. The increases in genetic variance would appear to be brought about by the mutations of fixed loci rather than of loci with intermediate gene frequencies.

1516 Valencia, R.M., Lindsley, D.L., Valencia, J.I., Muñoz, E. TOTAL RADIATION-INDUCED GENETIC DAMAGE TO ENTIRE GENOMES OF Drosophila melanogaster. p.227 of "3rd International Congress of Radiation Research. Cortina d'Ampezzo, Italy, 26 Jun.-2 Jul. 1966, 263p.". Abstr. 904.

A study is underway in which all the different kinds of genetic damage (lethals, sterility factors, morphological alterations and detrimental factors) and cytological damage (translocations, inversions and deletions), which have heretofore been measured more or less separately, are being measured in entire irradiated genomes of D. melanogaster. In the present experiment, males were x-irradiated with either 2000 R or 4000 R and mature sperm sampled. The males were mated to females of a balancer stock in which all the chromosomes bear phenotypic markers and/or crossover suppressors, and daughters bearing one irradiated genome and one balancer genome were collected. These were mated individually to balancer stock males, and the progeny of each female were mated among themselves in such a manner as to balance or make homozygous each chromosome of the genome. Genetic effects not detected already during this process were tested

for by appropriate crosses. Salivary gland preparations of all chromosomes of each genome were examined. The results obtained thus far (with 248 X-bearing and 138 Y-bearing genomes) demonstrate the feasibili' of studying total genome damage. (These results were presented in detail and the work planned and/or in progress was discussed.) (From abstr.)

1517 Valencia, R.M. THE FREQUENCY OF GENETIC DAMAGE IN ENTIRE IRRADIATED GENOMES. Radiat. Res. 31, 3 (1967) 613. Abstr. Eb-5. Presented at "15th Annual Meeting of the Radiation Research Society. San Juan, Puerto Rico, 7-11 May 1967".

By means of markers and/or crossover suppressors in all four chromosomes of Drosophila melanogaster, entire X- or Y-bearing irradiated genomes were collected and analysed for recessive lethals and sterility factors, dominant or recessive visibles and chromosome rearrangements of all kinds. 40 X-bearing genomes which received 2000 R of x-rays and 310 genomes (181 X-bearing and 129 Y-bearing) which received 4000 R delivered to mature spermatozoa have been completely analysed to date. Considering each point mutation (whatever its phenotype) and each chromosome break as a genetically altered "site", the results from the 4000 R group are as follows: 196 (63.2%) of the genomes surviving the irradiation and producing sufficient progeny to allow the collection and analysis of the entire genome were found to be genetically damaged to some extent. Of these, 97 had 1 damaged site, 63 had 2, 26 had 3, five had 4, three had 5 and two had 6 damaged sites. The total number of damaged sites in the 310 genomes was 348, or an average of 1.12 per genome. The average number of altered sites per chromosome was .188 for the X-chromosome, .194 for the Y-chromosome, .432 for chromosome II, .471 for chromosome III and .029 for chromosome IV, showing essentially a direct relationship between chromosome length and amount of inherited damage. Phenotypic effects (morphological changes, lethality, detrimentality and sterility) (will be) discussed in relation to one another and to the cytological nature of the alteration. (Abstr.)

1518 Vann, E. THE FATE OF x-RAY INDUCED CHROMOSOMAL REARRANGEMENTS INTRODUCED INTO LABORATORY POPULATIONS OF Drosophila melanogaster. Am. Nat. 100 (1966) 425-449.

Several lines of D. melanogaster of various geographic origins were subjected to intensive inbreeding for > 60 generations. Small samples of adult males were then taken from some of the inbred lines and irradiated (5000 R). Various types of structural rearrangements were induced in the sperm chromosomes; 30 chromosomal rearrangements were subsequently recovered and identified cytologically. Members of each culture that contained a newly-induced rearrangement (one of either 15 paracentric, or 9 pericentric inversions or 6 translocations) were mated to nonirradiated members of each of the other inbred lines to initiate a series of populations that at the start contained known frequencies of a specific rearrangement and that also possessed varying degrees of genic dissimilarity between the chromosomes of each pair of founding lines. After eight or nine generations, samples of larval salivary gland chromosome taken from each population were examined in order to determine the frequency of structural heterozygotes within the populations after having been subjected to the effects of "natural" selection. Paracentric inversions were found to be considerably more able to maintain structurally polymorphic populations than either the pericentric inversions or translocations. It could be shown that (a) individuals structurally heterozygous for a 2-break paracentric inversion suffer from an average selective disadvantage of 0.35, relative to non-inversion homozygotes, due to chromosome breakage (this was counteracted to varying degrees by the amount of genic heterozygosity included within the inverted segment); (b) a curvilinear relationship exists between the length of the inverted segment and structural heterozygote fitness, which again varies with the amount of genic heterozygosity included within the inverted segment; (c) individuals structurally heterozygous for chromosomes of unrelated origins maintain almost 50% more genic hybridity/small chromosome segment than do those whose chromosomes came from the same mass culture; and (d) from the relative success of the paracentric inversions in maintaining structurally polymorphic populations it was concluded that the genes contributing to fitness heterosis are well-scattered among the chromosome arms of this species. (Based on auth. summary)

1519 Vann, E.G. A GENETIC ANALYSIS OF INDUCED CHROMOSOMAL REARRANGEMENTS IN LABORATORY POPULATIONS OF Drosophila melanogaster. Diss. Abstr. 26 (1966) 6983.

This experiment was designed to gain information on the genetic basis of hybrid vigour through observations on the fate of newly-induced chromosomal rearrangements - especially paracentric inversions - in laboratory populations of D. melanogaster. The initial parental flies of the

different populations were hybrids obtained by matings between different inbred lines. After a min. of 62 generations of inbreeding, small numbers of males from each of eight inbred California lines were irradiated with 5000 R of x-rays and were mated to their unirradiated sisters. The F_1 progeny were used to set up some 200 single pair F_2 matings. Twelve F_2 progeny from each culture were sacrificed for cytological examination of salivary gland chromosomes. In this way, F_2 cultures in which flies carried newly-induced aberrations were identified. Each newly-induced rearrangement (15 paracentric inversions, 9 pericentric inversions and 6 translocations) was subjected to test within a series of twelve populations formed by crossing the rearrangement-bearing flies (1) to their own sibs, (2) to flies from their own inbred line, and (3-12) flies from ten other inbred lines. The resultant populations were kept in half-pint bottles by mass transfer of adults each generation; after a number of generations (generally eight or nine) the frequency of structural heterozygotes was determined in a sample of some 80 larvae. As expected, translocations and pericentric inversions were almost completely eliminated from the populations containing them. These aberrations in the form of paracentric inversions (with one exception) were retained in most populations. They were retained in high frequencies in populations whose parents were hybrids between distantly related strains. Longer paracentric inversions were retained in greater frequencies than shorter ones. It was estimated from the data that the average newly-induced aberration imposes a selective disadvantage of 35% on its heterozygous carriers; this disadvantage is the result of chromosomal breakage and, probably, associated genetic damage. Aside from this "inherent" disadvantage, the average selective advantages associated with the paracentric inversions were 0.40 in "Intrastrain" populations, 0.53 in "Interstrain" populations and 0.63 in "Unrelated" populations. The selective advantage increased with inversion length; this increase was as high as 0.60% per 1/120th of a chromosome arm in the case of the "Unrelated" populations. It was concluded that the genes responsible for heterosis are numerous and are scattered throughout the chromosome complement. Because of the pronounced relation between heterosis and inversion length, it seems unlikely that position effect contributed greatly to the observed hybrid vigour. (From DA)

See also :

1031 Equilibria for inversions induced by x-rays in isogenic strains of Drosophila pseudoobscura. (Sperlich, D., 1966)
1064 Viability of heterozygotes for induced mutations in Drosophila melanogaster. III. Mutations in spermatogonia. (Falk, R., 1967)
1065 Viability coefficients and preferential recovery. (Falk, R., 1967)
1095 Biological studies: genetics. (National Inst. of Radiological Sciences, Chiba (Japan), 1965)
1111 Genetic variability in Aedes aegypti (Diptera: Culicidae). II. Mutations causing structural modifications. (VandeHey, R.C. et al., 1962)
1342 Gross effects of gamma radiation on the Indian-meal moth and the Angoumois grain moth. (Cogburn, R.R. et al., 1966)
1423 Genetics of a heterozygous population of Drosophila melanogaster. I. Viability and population fitness of heterozygous CyLcn/cn110 carrier of irradiated chromosome cn110. (Shilenko, B.V., 1965)
1470 Fitness and competitive ability in irradiated populations of Drosophila melanogaster. (Dyer, K.F., 1966)
1488 An analysis of radiation-induced variation on body-weight of Habrobracon juglandis. (Dalebroux, M.A. et al., 1967)
1520 Evolution of fitness. III. Improvement of fitness in irradiated populations of Drosophila serrata. (Ayala, F.J., 1967)
1523 Male sphaeropthalmine mutillid wasps of the Nevada test site. (Ferguson, W.E., 1967)

2.3.5. Ecological Aspects

1520 Ayala, F.J. EVOLUTION OF FITNESS. III. IMPROVEMENT OF FITNESS IN IRRADIATED POPULATIONS OF Drosophila serrata. Proc. natn. Acad. Sci. U.S.A. 58, 5 (1967) 1919-1923.

The experiment was designed to allow for the incorporation by recombination of the newly induced mutants in the gene pool before strong natural selection was applied. In one experiment 2000 males

were irradiated with 2000 R x-rays, and mated. Males of the progeny were again irradiated with 2000 R, and mated; samples of males from the subsequent progeny were withdrawn, and again irradiated and mated. The genome of the males in the experimental populations received on the average 4000 R. The females received various amounts of radiation, averaging 2000 R. (Further experimental details are given.) - Genetic variability induced by x-irradiation augmented, after selection, the adaptedness of two populations of D. serrata to a new environment.

1521 Ayres, R. U. SPECIAL ASPECTS OF ENVIRONMENT RESULTING FROM VARIOUS KINDS OF NUCLEAR WARS. PART II, ANNEX IV. EFFECTS OF THERMONUCLEAR WAR ON WEATHER AND CLIMATE. HI-303-RR/A-IV, Hudson Inst., Inc., Croton-on-Hudson, N.Y. 8 Jan. 1964. 29p.

An admittedly superficial view of some possible consequences of a thermonuclear war for weather and climate suggests the possibility of a sequence of meteorological and climatic events roughly as follows, following an attack of 10 000 MTs (ground-burst): initial widespread dirty (contaminated with fallout) rains and/or snow lasting several weeks; fairly heavy haze in the stratosphere, gradually disappearing over a period of several (i.e., 3-4) years; many forests on lower slopes killed or weakened by radiation, followed by insect outbreaks (2nd, 3rd, and subsequent years); enhanced wind and water erosion where plant cover is depleted; loss of forest cover on watersheds resulting in higher soil temperatures; and ultimately, higher ground temperatures, fewer forests, some marginal lands turned into desert, and many river valleys damaged by floods. (Auth.)

1522 Dispons, P. LES HETEROPTERES DE REGAN (HEMIPTERA, HETEROPTERA). Rev. Serv. biol. vétér. Armées, Fr. 17, 4 (1964) 139-142.

Conséquences biologiques des effets nucléaires sur les Arthropodes. Aspects biogéographiques et composition de la faune entomologique saharienne. (Bull. sign. biophysique-biochimie)

1523 Ferguson, W. E. MALE SPHAEROPTHALMINE MUTILLID WASPS OF THE NEVADA TEST SITE. Brigham Young Univ. Sci. Bull., Biol. Ser. 8, 4 (1967) 1-26.

An ecological and taxonomical study of the sphaeropthalmine Mutillidae of the Nevada Proving Grounds Area was made. Important contributions to the data on distribution and taxonomy of the nocturnal Mutillidae are also included; new species of male mutillids are described. It was shown that former ground zeros of nuclear detonations were reoccupied by the mutillids within a few years after a blast or series of blasts. A careful search for anatomical changes among the Mutillidae collected at the test site revealed that the nuclear testing did not produce any genetic abnormalities. (NSA 21: 1967, 39502)

1524 Goates, M. A. MITES ON KANGAROO RATS AT THE NEVADA TEST SITE. Brigham Young Univ. Sci. Bull., Biol. Ser. 3, 4 (1963) 1-12.

A systematic study of parasitic mites on kangaroo rats of two species at the Nevada Test Site was conducted from Aug. 1959 - Dec. 1961. The intent was to determine the kinds, numbers, seasonal occurrences, and ecological relations of mites in nuclear disturbed and contiguous undisturbed areas. A total of 1256 rats from nine plant communities was examined. Data are summarized. (NSA 18: 1964, 13)

1525 Payne, J. A., Crossley, D. A., Jr. ANIMAL SPECIES ASSOCIATED WITH PIG CARRION. ORNL-TM-1432, Oak Ridge National Lab., Tenn. Apr. 1966, 67p.

Following a nuclear attack, carrion remains of domestic animals could pose difficulties for human survival because of public health and sanitation problems associated with carrion. Insects influence the course and rate of decomposition, and radiation effects on insect populations could alter the normal decomposition pattern. A study was made of the animal community in pig carrion, preliminary to experimental research on the influence of radiation and other factors on succession in carrion. A total of 522 animal species representing 3 phyla, 9 classes, 31 orders, 151 families, and 359 genera were found associated with various decomposition stages. A systematic list of all species, their abundance, microhabitat, and food relationships is given. (Auth.)

1526 Southwood, T. R. E. "Ecological Methods with Particular Reference to the Study of Insect Populations". London, Methuen & Co. Ltd., 1966. 391p.

Radioisotopes, their use and the results obtained and obtainable are discussed in connection with marking insects (p. 58, 63-71, 80), the labelling of predators via labelled prey (p. 251-253), the measurement of feeding rates and assimilation (p. 361-363), and respiration studies (p. 367). The application of radiographic techniques to the detection of insect infestation in grain, other seeds, in moist plant tissues (wood-borers, stem borers, and bollworms), etc. (p. 121), are described.

1527 Sperlich, D., Karlik, A., Pohl, E. MUTAGENIC ACTIVITY OF RADON-222 IN Drosophila melanogaster. Strahlentherapie 132, 1 (1967) 105-112. (In German)

Male Drosophila were kept in a Rn-containing atmosphere and the percentage of the lethal mutations induced in the sex chromosome was determined. The spontaneous mutation rate was 0.17%, it was 0.37 ± 0.18% when the flies were kept for 24 h in an atmosphere containing 2.8 μCi Rn/l, 2.42 ± 0.57% when they were kept for 24 h in 78.6 μCi Rn/l, and 0.35 ± 0.17% after a 21-d stay in the natural Rn atmosphere of the mine in Badgastein/Boeckstein (with 0.0035 μCi/l). The effect of the 24-h exposure to 78.6 μCi/l was calculated to correspond to 576 R x-rays. (CA 66: 1967, 73026k)

1528 Woodwell, G.M. EFFECTS OF IONIZING RADIATION ON NATURAL ECOSYSTEMS. BNL-7200, Brookhaven National Lab., Upton, N.Y. nd., 11p.

The characteristic patterns of natural ecosystems are outlined, and types of changes produced in these patterns by ionizing radiation are discussed. Potential levels of radiation exposure produced by nuclear war are estimated. Data are summarized from studies of radiation effects on natural ecosystems. It is concluded that total radiation exposures in the range of 5 000-10 000 R in a six-month period would kill more than 90% of the trees of most deciduous forests, and exposures in the range of 1000-3000 R would damage coniferous forests similarly, while grasslands, weed fields, and tundra would be substantially more resistant. Coincident with the radiation damage to plants in such systems there would be fluctuations in insect and animal populations. Radiation exposures in the range of 1000-10 000 R are well within the range of exposures from fallout that could be expected from a nuclear attack. (NSA 18: 1964, 35306)

See also III/1417.

1529 Woodwell, G.M., Ed. p.20-38 of "Ecological Effects of Nuclear War". BNL-917 (C-43), Brookhaven National Lab., Upton, N.Y., 1965, 72p.

The kinds of effects discussed are not individually unique to nuclear catastrophe. Most can and do result from a variety of non-nuclear forces. Unique features would be (1) the interaction of several severe limiting factors, with total effect not simply the sum of component effects, and (2) the great size of the stressed area, which probably influences the rate of recovery more than the severity of the acute forces themselves. As regards insect populations, the principal changes after irradiation have been found to follow changes in the abundance of food. There might be temporary upsurges (e.g. in the case of defoliators) of certain species.

1530 Woodwell, G.M., Brower, J.H. AN APHID POPULATION EXPLOSION INDUCED BY CHRONIC GAMMA IRRADIATION OF A FOREST. Ecology 48, 4 (1967) 680-683.

A population explosion of the aphid, Myzocallis discolor Morell, occurred on white oaks (Quercus alba) damaged by chronic γ-irradiation. Oaks exposed to 9.5 R/d during 18 months supported max. aphid populations of 25 winged adults per leaf (350 000/m^2 of forest). The aphid was not found in the undamaged forest. The irruption was correlated with changes in predator populations and with small changes in the sugar, total N and lipid content of white oak leaves. The relative importance of these two sets of factors could not be determined. (Auth.)

See also:

1492 Chromosomal polymorphism in irradiated natural populations of Chironomus. (Blaylock, B.G., 1966)
1493 Cytogenetic study of a natural population of Chironomidae inhabiting an area contaminated by radioactive waste. (Blaylock, B.G., 1966)
1494 Population genetics and radiation effects studies. (Blaylock, B.G., 1966)
1557 Computer simulation of the sterile male theory. (Berryman, A.A., 1966)

2.4. APPLICATIONS

2.4.1. General Articles. Recommendations. Surveys

1531 Anonymous. THE POTENTIAL ROLE OF THE STERILITY METHOD FOR INSECT POPULATION CONTROL WITH SPECIAL REFERENCE TO COMBINING THIS METHOD WITH CONVENTIONAL METHODS. ARS-33-98. 1964, 54p. Agricultural Research Service, United States.

1532 Beard, R.L. RADIATION, INSECTS AND FOOD PRESERVATION. p. 23-25 of "Papers on Certain Aspects of Food Preservation". THAI-AEC-9, Office of Atomic Energy for Peace, Bangkok (Thailand). 6 Sep. 1966, 34p.

Very general introductory article.

1533 Cavalloro, R. L'IMPIEGO DELLE RADIAZIONI IONIZZANTI E DEGLI ISOTOPI RADIOATTIVI IN ENTOMOLOGIA AGRARIA. (The application of ionizing radiations and radioisotopes to agrarian entomology.) Paper presented at the "Convegno sulle Applicazioni dell'Energia Nucleare in Agricoltura. Novara, Italia. 5-7 maggio, 1961". (In Italian, with English and French summaries)

Survey.

1534 Descamps, M., Wintrebert, D. POSSIBILITES D'UTILISATION DES FACTEURS BIOECOLOGIQUES DE LIMITATION DES ACRIDIENS MIGRATEURS. Entomophaga 11, Pt.2 (1966) 217-229.

Several bioecological factors liable to reduce the number and the nocivity of locusts are reviewed and discussed, among them genetic factors (very briefly), involving the sterilisation of males, and irradiation with genotypic purpose. Tropic and trophic factors, biotic factors and eco-climatic factors are also discussed, in more detail.

1535 Fowler, E.E. NEW DEVELOPMENTS AND TRENDS IN THE ISOTOPE INDUSTRY. Isotopes Radiat. Technol. 3 (1966) 185-192.

Uses of isotopes and radiations are discussed. The dimensions of the growth of industrial uses in the United States are illustrated. Tracer methodology and applications, radioisotope gauging, radiography, process radiation development, radiation preservation of food, and isotopic power are considered. (NSA 20: 1966, 37142)

1536* Huque, H. ROLE OF ATOMIC ENERGY IN INSECT STUDY AND CONTROL. Agriculture Pakist. 13 (1962) 77-80.

Uses of radioisotopes and ionizing radiations in entomological research, and particularly in radio-sterilisation eradication programmes are reviewed. Programmes whereby sterilisation of insect pests and their complete eradication were achieved by radioisotopes are exemplified by screw-worm fly. Consideration is given to use of the sterilised-male method on fruit flies and to the use of ionizing radiation to kill other insects, particularly pests in clothing, packaged foodstuff, and wood products. A device for the control of stored grain pests and the pink boll worm is described. The effect of γ-radiation on silkworm cocoons, with reference to technological properties of raw silk, is also discussed. (NSA 21: 1967, 34846)

* Originally listed as III/1067, without abstract.

1537 International Atomic Energy Agency, Vienna (Austria) and Food and Agricultural Organization of the United Nations, Rome (Italy). JOINT RECOMMENDATIONS OF THE COORDINATING MEETING ON RESEARCH ON MUTATIONS IN RICE BREEDING AND THE PANEL MEETING ON CONTROL OF RICE INSECTS USING RADIATION. Int. Rice Commn Newsl. 15, 3 (1966) 34-37. Also presented at "2nd Meeting on the FAO/IAEA Coordinated Programme of Research on the Use of Induced Mutations in Rice Breeding 1965/1966. Manila, Philippines. 21-25 Feb. 1966".

It was recommended that the training and knowledge of plant breeders be utilized by entomologists in evaluating radiation effects on insects; that irradiation dosages at various developmental stages be determined (lethal and sterilising doses, and doses inducing dominant lethality) for the stem

borer: also, the competitiveness of adult males, and the vigour of emerged adults in relation to dosage and stage of irradiation. The need for ecological studies of field populations was stressed. In addition to the rice stem borer, Chilo suppressalis, the rice gall midge, Pachydiplosis oryzae, and the leafhoppers Sogota, Nilaparvata and Nephottetix are considered to be serious in some parts of Southeast Asia, India and Pakistan. The need for more detailed studies on their field ecology and the field population outside the paddy field or in off-season of rice growing was stressed.

1538 Jafri, R.H. PROSPECTS OF INTEGRATED MICROBIAL AND RADIATION CONTROL OF HARMFUL INSECTS. J. invertebrate Path. 9, 3 (1967) 293-297.

This paper is a "theoretical insect pathology" consideration of the prospects of integrated microbial and radiation control of harmful insects. While considering this topic our attention is directed first to the possible applications of the radiation sterilising method of population suppression. The exploratory investigations of this subject have shown that ionizing radiation will induce sterility but there is considerable variation in the amounts needed. The research also suggests that radiation damage may in some cases prevent application of the method to some insects. In nature some insects appear to be so abundant that the use of the sterile-male technique may not be feasible without first processing the geographically isolated and non-isolated infested area with other control measures to bring wild populations "within reach". Such a situation can be approached from two angles. The population may be controlled by means of well-tried microbial pathogens. Also, the release of sterile male insects carrying parasites or pathogens has control possibilities. In such a situation an intensified search has to be made for those pathogens that are non-virulent when present in or on the adult, but are highly virulent to the larvae. Coelomomyces and Theiohania are probably of this category. - The increased susceptibility of irradiated insects to pathogens is opening a new field of investigation. The life span of Tribolium castaneum and T. confusum beetles was shortened considerably when the test insects received Bacillus thuringiensis immediately and after an interval of 24 and 144 h following exposure to x-rays. The life span of the irradiated beetles was somewhat shortened by the presence of Farinocystis tribolii, Nosema whitei, and Adelina tribolii, protozoan parasites in the fat body of the test insects. - There are promising prospects of evolving, through irradiation, new strains of pathogens of high virulence. Already, strains of increased virulence of Beauveria bassiana and Aspergillus flavus have been evolved by means of ionizing radiation. There is economic feasibility in using γ-radiation from ^{60}Co in the control of diseases of the honey bee, and in the sterilisation of honey. The use of radiation as an insect repellent and the behavioural aspects of radiation on insects is a fascinating field of future investigation. Examples of this phenomenon are cited. (Auth.)

1539 Kloft, W. INSEKTEN VERNICHTEN SICH SELBST. (Insects annihilate themselves.) Naturw. u. Medizin 3, 13 (1966) 29-37. (In German)

Review of the principle and the commercial successes to date of the sterile-male technique. Achievements based on radiosterilisation, and the usefulness of chemosterilants are discussed.

1540 Lagoni, H.L. RADIOAKTIVE STRAHLEN IN DER LAND - UND ERNÄHRUNGSWIRTSCHAFT. (Radioactive irradiation in agriculture and food production.) Verbraucherdienst 6 (1961) 210-211. (In German)

The application of α-, β-, and γ-radiation for combating insects, the sterilisation of food products, mutation breeding of crop plants and in animal husbandry, are discussed. Radioisotopes have already been applied successfully (with examples) in agricultural research and practice, and their application is on the increase.

1541 Laven, H. GENETICS AGAINST PESTS. Bild. Wiss. 6 (1966) 447-453. (In German)

General article stressing the need for new genetic methods of insect control, in view of the rapid general increase in the resistance developed by insects against chemical agents. In 1945 this was noted with Danish houseflies for the first time. By 1950 the resistance of 11 different types of disease-carrying insects had been established. There were 81 types by 1962, by now there probably are 100 types. At first it was believed that this resistance was due to acquired tolerance but it was later found to be based on genetic biochemical differences. The principles of the sterile-male technique are discussed, with examples drawn from experience to date. The general problems inherent in the method are considered.

1542 Lourie, I.M., Shea, T.E. PROTECTION AGAINST IONIZING RADIATIONS. OUTLINES, DESCRIPTION, AND CONSIDERATIONS OF THE ESTABLISHMENT OF PROGRAMS OF THIS TYPE IN THE AMERICAS. Boln. Of. sanit. pan-am. 51 (1961) 113-118.

A programme is being developed under the auspices of the World Health Organization for protection from radiation and proper utilization of nuclear energy in the Americas. A programme of aid has been developed by the Oficina Sanitaria Panamericana (OSP) consisting of four major points, one of them the promotion of the use of radioisotopes for diagnostic, therapeutic, and research purposes, and the promotion in Latin America of research projects related to radiation and its effects. Possibilites are suggested for application of the sterile-male technique, with the object of exterminating certain diseases in Latin America. The help of OSP is promised with the provision of consultants for all four points of the programme, as well as scholarships for the training of all types of personnel.

1543 Manowitz, B. GAMMA RAYS FOR FUN AND PROFIT. BNL-50084, Brookhaven National Lab., Upton, N.Y. 20 Apr. 1966, 13p.

The history of programmes to find uses for fission products is reviewed briefly. The γ-emitting radioisotopes, ^{60}Co and ^{137}Cs, are described in detail as to characteristics, availability, and the design of irradiators using these sources. The results of specific applications of γ-radiation to insect control, food preservation, and polymerization studies are presented. (NSA 22: 1968, 12534)

1544 Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt). ANNUAL REPORT, JANUARY 1, 1965-DECEMBER 31, 1965. NP-16547. Jan. 1966, 38p.

Activities in the training of specialists in the application of radioisotopes in science, industry, agriculture, and medicine and in research using radioisotope techniques are reported. Progress on eradication of Anopheles pharoensis and Ceratitis capitata by radiosterilization techniques is reported. A list of 29 references to papers published on work performed at the centre is included.

1545 Moh, C.C. THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Triennial Report, July 1, 1963 - June 30, 1966. NYO-2043-130, Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica). 171p.

Applications of atomic energy in the development of improved strains of agricultural plants, better control of plant diseases and insect pests, and the proper management and use of soils are discussed for countries in the American tropics. The use of γ-radiation for the control of Mediterranean fruit fly, Ceratitis capitata, the tropical warble fly, Dermatobia hominis, the parasitic larvae of which cause cutaneous myiasis in cattle, and the coffee leaf miner, Leucoptera coffeella, was investigated. Results are reported from extensive studies on the biology of these species. A list is included of publications during the period covered by this report.

1546 Nagy, B., Pozsár, B., Szalay-Marzsó, L. SUGÁRZÁSOK ALKALMAZÁSA ÁLLATI KÁRTEVÖK ELLENI VÉDEKEZÉSBEN. (The use of ionizing radiations for the control of harmful animals.) Kiad. Orz. Atomenerg. Bizottság Izotóp Int. 15 [5+] iii, iii, 83p., multigraph. Budapest 1965. (In Hungarian)

This is a review of the world literature compiled for use in Hungary, and it contains sections on the general effects of radiation on animals and animal tissues, the use of radiation for the control of insect pests, whether directly, as in the radiation of infested foodstuffs, or indirectly, as in the sterilisation of males for subsequent field release, and the possible value of such techniques in Hungary. (RAE-A 54, 12: 1966, 633)

1547 Nelson, S.O. TOWARDS BETTER INSECT CONTROL. Crops Soils 18, 1 (1965) 8-9.

Use of ionizing and non-ionizing radiations to control insect pests is reviewed, including the sterile-male technique. Doses of radiation that kill insects do not damage wheat for milling and baking or affect nutritional qualities to any noticeable degree. The U.S. Food and Drug Administration has approved wheat irradiation by γ-ray sources for insect control. Electron irradiation of wheat and γ-irradiation of citrus are also under consideration by the FDA. Current estimates of costs for treating grain with radiation are somewhat higher than costs for chemical insecticide treatment. As the nuclear and electronic industries develop further, however, costs for ionizing radiation are

expected to decline substantially. The eventual application of radiation for control of stored-product insects can be expected.

1548 Nelson, S.O. ELECTROMAGNETIC ENERGY. p. 89-145 of "Pest Control. Biological, Physical, and Selected Chemical Methods". Kilgore, W., Doutt, R.L., Eds. New York, Academic Press. 1967, 477p.

Various forms of electromagnetic energy have long been recognized as offering possible means for insect control. The electromagnetic spectrum is discussed, and the particular energy ranges (radio-frequencies, infra-red, visible, and u.v.) are considered in some detail. The use of ionizing radiations (x- and γ-rays) are dealt with on p. 129-137, the illustrations used being amply documented as part of the bibliography on p. 139-145.

1549 Sigurbjoernsson, B. INTERNATIONAL COOPERATION IN MUTATION BREEDING RESEARCH. Qualitas Pl. Mater. veg. 13 (1966) 389-394.

Cooperative studies being carried out under unified control by various nations for using ionizing radiations, neutrons, and other mutational agents for crop improvement are briefly discussed. The Joint FAO/IAEA Division of Atomic Energy in Agriculture is conducting several internationally coordinated programmes of research in the fields of mutation research, insect eradication, fertilizer efficiency studies, and food preservation. Participating scientists in each of these programmes work on the same general problems and coordinate their approach to solving them. This is done in some cases by having all participants run identical field experiments, in other cases by the distribution of specific tasks or by combined efforts to solve certain problems as appropriate. Once a year the participants in these programmes meet to report on their research activities and to coordinate their research programmes for the ensuing year.

1550 Zeeuw, D. de. FOOD IRRADIATION - AN IMPROVEMENT TO HUMAN DIET. Euratom Bull. 3, 3 (1964) 15-17.

Research carried out in the past 20 years to evaluate irradiation as a tool for food preservation is summarized. Attention is given to studies of: sprout inhibition in potatoes and onions, extension of shelf life of fresh fruit and vegetables, insect control in cereals and flour products, and improvement of dairy products. (NSA 18: 1964, 39762)

1551 Zeeuw, D. de. RESEARCH ACTIVITIES OF THE ASSOCIATION EURATOM-ITAL. Atompraxis 12 (1966) 231-236.

Research activities of the Association Euratom-ITAL (Instituut for Toepassing van Atoomenergie in de Landbouw Wageningen) are directed towards the practical application of radiation and radioactive elements and compounds in the field of agriculture, particularly in the spheres of food technology, growth and development of plant and animal, pest and disease control, and breeding. Results achieved thus far and new perspectives for the use of nuclear techniques in the field of agriculture are outlined. Pilot plant applications of ionizing radiations are in an advanced stage in various countries, in particular the USA, Turkey, Argentina, for the control of insects in their products (fruit, grains, cereal products). There is a growing interest in the disinfestation of tropical fruit, such as papayas, mangoes and pine-apples. Emphasis is to be placed on the application of the sterile-male technique to Ceratitis capitata, Dacus oleae, and the onion fly.

See also:

42 The use of radionuclides and their radiation in (the) plant pest control. (Haisch, A. et al., 1966)
910 Biological Effects of Radiations. (Grosch, D.S., 1965)
1629 Control and sterilization of pests of grain storages by gamma rays. (Dockal, J. et al., 1965)
1666 The Israel food irradiation programme and progress during 1964-1966. (Kahan, R.S. et al., 1966)
1668 Food irradiation research and pilot facilities in operation or planned in India. (Kumta, U.S. et al., 1966)
1676 Recent advances in food irradiation research in Japan. (Matsuyama, A., 1966)

1769 Ionizing radiations in applied entomology. (Cadahia, D., 1965)
1770 ibid (1966)
1790 International experience in the use of radioisotopes. (Zeleny, V., 1963)

2.4.2. Population Control

1552 Smith, C.N. NEW APPROACHES TO THE CONTROL OF PEST ORGANISMS. p. 145-150 of "Pesticides and Their Effects on Soils and Water. ASA Special Publication No.8". Madison, Wis., USA, Soil Science Society of America, Inc. 1966, 150p. Paper was also presented at the "Annual Meeting of the Soil Science Society of America. Columbus, Ohio, USA. Nov. 1965".

An introductory article, dealing with induced sexual sterility and its usefulness for eradicating certain species of insects. - The importance of research on attractants is stressed.

1553 Knipling, E.F. SOME BASIC PRINCIPLES IN INSECT POPULATION SUPPRESSION. Bull. ent. Soc. Am. 12, 1 (1966) 7-15.

Information gained from the screw-worm population control programmes is discussed. The author considers characteristic trends of insect populations subjected to different systems of control. The system of insect control by the use of conventional insecticides is concluded to be highly efficient in terms of numbers of insects destroyed when the insect population density is high but highly inefficient when the population is low. The contrary is true of the system of sterile insect release. However, the latter, when used in conjunction with the insecticide system of insect control provides a means of reversing the law of diminishing returns in dealing with the elimination of insect populations. The application of the basic principles of integrating chemical treatments and sterile insect releases for the control of a specific insect is discussed, theoretical models being used. The problem of the boll weevil is considered, and the projects under way for dealing with the pest. — The integration of predator (or parasite) releases and sterile insect releases, which independently affect different stages of the host insect provides a more efficient system of insect population control than either system employed alone. The integration of cultural control and release of sterile insects for tobacco hornworm (Manduca sexta (Johannson)) control is considered. - The author deliberately omitted any discussion here of the basic principles involved in the use of insect attractants and chemosterilants.

2.4.2.1. Sterile Male Technique

1554 Ailam, G., Galun, R. OPTIMUM SEX RATIO FOR THE CONTROL OF INSECTS BY THE STERILITY METHOD. Ann. ent. Soc. Am. 60, 1 (1967) 41-43.

Formulae are derived for the expected number of fertile eggs laid by a population containing fertile and sterile individuals. It is concluded that introduction of sterile individuals of the two sexes, for control of population, is never inferior, and sometimes even superior, to the introduction of one sex alone. (Auth.)

1555 Anonymous. IRRADIATION, A BIOLOGICAL CONTROL WEAPON AGAINST OMNIVOROUS LEAF ROLLER AND CODLING MOTH. Agric. Res., Wash. 14, 5 (1965) 7.

1556 Arroyo Varela, M., Jimenez, A., Mellado, L., Caballero, F. APPLICATION OF RADIOACTIVE ISOTOPES TO THE INVESTIGATION OF METHODS OF BIOLOGICAL CONTROL OF INSECT PESTS. I-V. TESTS WITH P-32 AND GAMMA-RAYS ON Ceratitis capitata. Boln Patol. veg. Ent. 28 (1965) 233-298. (In Spanish)

1557 Berryman, A.A. COMPUTER SIMULATION OF THE STERILE MALE THEORY. Bull. ent. Soc. Am. 12 (1966) 263. Abstr. 335, presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

A computer programme based on the mathematic description of the sterile male theory facilitated the determination of release strategies and prediction of the effects following release. The theory

may also be applied to ecological research, particularly in determining population survival parameters. (Abstr.)

1558 Collins, P. GENETIC WEAPONS. POPULATION REPLACEMENT, INDUCED STERILITY, OR THE INTRODUCTION OF DELETERIOUS GENES - ARE ALL PROMISING BIOLOGICAL METHODS OF FIGHTING DESEASE-CARRYING INSECTS. New Scient. 21 (1964) 351.

Survey article on autocidal control measures, pin-pointing Craig's (WHO) review article on how one might attack the problem of certain insect vectors of (human) diseases. These measures are discussed. Sterility may be induced by irradiation or chemically. The principle of meiotic drive is described.

1559 Cutcomp, L.K. PROGRESS IN INSECT CONTROL BY IRRADIATION INDUCED STERILITY. PANS 13, 1 (1967) 61-70.

Requirements, advantages and disadvantages of the sterile-male release technique are discussed. The more important insects studied in relation to the possibility of employing the sterile male technique are summarized in a table. Those starred have research support by the IAEA. Except where stated, host damage is attributable to the immature or larval stage.

A. Progress good to excellent

Pest	Hosts
Screw-worm (Cochliomiya hominivorax)	cattle, livestock
*Mediterranean fruit fly (Ceratitis capitata)	citrus and other fruits
*Melon fly (Dacus cucurbitae)	cucurbits
Mexican fruit fly (Anastrepha ludens)	citrus, mangoes
Oriental fruit fly (Dacus dorsalis)	most fruits

B. Considerable progress, but application of technique either small scale or requiring further study

Pest	Hosts
*Olive fly (Dacus oleae)	olives
*Codling moth (Carpocapsa pomonella)	apples, pears
Pink bollworm (Pectinophora gossypiella)	cotton
Gypsy moth (Porthetria dispar)	forest and shade trees
Cockchafers (Melolontha vulgaris) - Larvae	grasses
- Adults	deciduous trees
Boll weevil (Anthonomus grandis) - Larvae and adults	cotton
*Tsetse flies (Glossina sp.)	cattle, livestock

C. Application may be feasible, but much more research needed

*Dacus zonatus
*Dacus ciliatus
Corn earworm (Heliothis zea)
Tobacco budworm (Heliothis virescens)
Tobacco hornworm (Manduca sexta)
*Torsalo or Tropical Ox Warble (Dermatobia hominis)
Sugarcane borer (Diatraea saccharalis)
European corn borer (Ostrinia nubilalis)
Oriental fruit moth (Grapholitha molesta)
Rice stem borers: *Chilo suppressalis
Tryporyza incertulas

1560 Hathaway, D.O., Butt, B.A. THE STERILITY APPROACH TO INSECT-CONTROL. p. 28-34 of the "72nd Annual Meeting. Transactions of the State Horticultural Society. 1966". (PDB 3:1967, 16133)

1561 Hurpin, B. RESULTATS ET PERSPECTIVES DE LA LUTTE BIOLOGIQUE CONTRE LES Oryctes. Oléagineux 21, 2 (1966) 77-82.

Various methods of combating the insect (particularly Oryctes rhinoceros) are discussed. Before even the possibility of eventually applying the sterile-male technique could be considered certain basic research would be required and is indicated briefly (p. 80).

1562 International Atomic Energy Agency, Vienna (Austria). A. THE IAEA LABORATORY AT VIENNA AND SEIBERSDORF. Second Report. IV. AGRICULTURE. B. INSECT ERADICATION AND PEST CONTROL. 5. CO-ORDINATED PROGRAMME ON INSECT ERADICATION AND STERILE-MALE TECHNIQUE. p. 24 of "Technical Reports Series No.41". Vienna, International Atomic Energy Agency. 1965, 106p. STI/DOC/10/41.

Two insect rearing rooms with controlled light, temperature and humidity were installed for the rearing of Mediterranean fruit flies and olive flies. Radiation research is being conducted to compare the dosages of neutrons and γ-radiation required to sterilise Ceratitis capitata. Results to date indicate that there is little difference in either the amount of γ-radiation or neutron radiation necessary for sterilisation.

1563 Katiyar, K.P. CONTROL DE UNA POBLACION DE INSECTOS, UTILIZANDO EL METODO DE MACHOS ESTERILES. (Control of an insect population by means of the sterile male technique.) (1) Presented at the Symposium on "Moscas de los Frutos. Asunción, Paraguay, 21-26 Aug. 1967. Organized by CIPA (Comité Interamericano de Protección Agrícola". n.p. (In Spanish) Also published as report (2) NYO-2043-151, n.d.

Essentially a survey.

1564 Kloft, W. ATOMENERGIE ZUR SCHADINSEKTEN-AUSROTTUNG. BERICHT ÜBER NEUARTIGE BEKÄMPFUNGSVERFAHREN MITTELS FREILASSUNG STRAHLENSTERILISIERTER INSEKTEN IN USA. (Atomic energy for the eradication of insect pests. Account of novel methods of pest control by the release of radiation-sterilized insects in the USA.) Sonderbeitrag über die Arbeit der Universität Würzburg. M.P. 12.2.1964. (In German)

1565 Knipling, E.F. THE STERILITY METHOD OF PEST POPULATION CONTROL. p. 233-249 of "Research in Pesticides. Proceedings of the Conference on Research Needs and Approaches to the Use of Agricultural Chemicals from a Public Viewpoint. Davis, Calif., USA, 1-3 Oct. 1964". Chichester, C.O., Ed. New York, Academic Press. 1965, 380p.

Review of the principles involved, and the basic knowledge required of the biology and ecology of the pest before control measures can even be considered by the sterility method. The current status is discussed. Examples of ways in which sterile insect releases might be employed to regulate populations of certain pests are given. A table illustrates a hypothetical model showing trends of boll weevil populations on 1000 acres of cotton when subjected to various treatment systems. The theoretical trend of a low-density tsetse fly population, averaging 200 flies/mile^2, is shown when subjected to sterile male releases at rates and for periods indicated in the table (II). A third table illustrates the estimated trend of the tobacco hornworm population east of the Mississippi river subjected to sterile moth releases in a 2-yr programme. - Some consideration is also given to vertebrate pests.

1566 Knipling, E.F. FURTHER CONSIDERATION OF THE THEORETICAL ROLE OF PREDATION IN STERILE INSECT RELEASE PROGRAMS. Bull. ent. Soc. Am. 12, 4 (1966) 361-364.

An attempt is made to predict population suppression due to parasites and predators. The effect of releasing into the natural population large numbers of sterile males and sterile egg-laying females in terms of increasing egg parasitism and/or predation, and the various assumptions made and the additional information required are discussed.

1567 Knipling, E.F. KNIPLING ON PEST CONTROL. Agric. Chem. 21, 4 (1966) 34-36. Also presented at the Symposium on "Scientific Aspects of Pest Control. Washington, D.C., USA, 1-3 Feb. 1966".

Survey.

1568 Knipling, E.F. STERILE TECHNIQUE - PRINCIPLES INVOLVED, CURRENT APPLICATION, LIMITATIONS, AND FUTURE APPLICATION. p. 587-616 of "Genetics of Insect Vectors of Disease". Wright, J.W., Pal, R., Eds. Amsterdam, Elsvier Publishing Company. 1967, 784p.

The author discusses the general principles involved in the control of insect populations by release of sterile insects and briefly reviews the current situation in regard to research in this field and the practical application of the method, by reference to the screw-worm fly [Callitroga hominivorax (Coquerel)], fruit flies and Glossina spp., with a short note on the development of chemosterilants for insect control. (RAE-B 56: 1968, ref. 562)

1569 LaChance, L.E., Schmidt, C.H., Bushland, R.C. RADIATION-INDUCED STERILIZATION. p. 147-196 of "Pest Control. Biological, Physical, and Selected Chemical Methods". Kilgore, W., Doutt, R.L., Eds. New York, Academic Press. 1967, 477p.

Comprehensive review article. The article first considers the development of the sterile-male theory, the components of sterility, the physiological and cytogenetic basis for various kinds of sterility (infecundity, inability to mate, sperm inactivation, dominant lethal mutations, aspermia), types of sterility induced in various male insects, and the type of sterility desired for insect control programmes. The section on applications deals with the screw-worm eradication programmes, and with field trials for control, broken down into work on Diptera [fruit flies, Lucilia sericata Meig., Musca domestica, and mosquitoes], Lepidoptera [Carpocapsa pomonella (L.), Paramyelois transitella (Walker)], and Coleoptera [Melolontha vulgaris (F.)]. An entire section (p. 182-193) is devoted to research needs: the comparative radiosensitivity of various species is discussed [illustrated by a table (p. 184-187)]; also, factors relevant to the success of future field trials, which include satisfactory and economical rearing methods, quantitative data on natural populations, a practical method of inducing sterility, and a knowledge of the components of sterility.

1570 Landa, V., Řežábová, B. PROBLÉMY STERILISACE HMYZU. (Problems in insect sterilization.) Agrochémia, Bratislava 5 (1966) 150-152. (In Czech)

Review article. Recent progress in inducing sexual sterility in insects by chemosterilants and the results of trials carried out on Lasioderma sericorne and Cochliomyia hominivorax are discussed. The chemosterilants are classified, and the conditions under which the technique can be applied are given. The comparison between radiation- and chemical sterilization of Musca domestica L., and future work in this field to be done at the Institute of Entomology in Prague are briefly outlined.

1571 Lawson, F.R. INTEGRATING CONTROL OF PEST POPULATIONS IN LARGE AREAS. p. 27-45 of "Proceedings of the FAO Symposium on Integrated Pest Control, Pt.3, Rome, Italy. 11-15 Oct. 1965". Rome, Food and Agriculture Organization of the United Nations. 1966, 129p.

In the review of experimental data the sterile male releases as used in the eradication of the melon fly, Dacus cucurbitae Coq., from Guam are discussed. The bulk of the article is not concerned with radiosterilization but views the problem of pest control as one requiring a co-ordination of various techniques.

1572 Lawson, F.R. THEORY OF CONTROL OF INSECT POPULATIONS BY SEXUALLY STERILE MALES. Ann. ent. Soc. Am. 60, 4 (1967) 713-722. (Errata Note: ibid. 60, 5 (1967) 1076).

The theory of control of insect populations by the release of sexually sterile populations or by treating field populations is examined by establishing basic premises and deriving algebraic equations. The effect of multiple mating is shown to depend on the fertility of females mated to both sterile and fertile males. The effect of release of males alone will be the same as release of both males and females when the released females are sterile; the effect of release of females alone will depend on the number of times males can mate. If a population is seasonally cyclic, the timing of initial releases will have no effect on the number of sterile adults or the time required for extermination, but the initial reduction will be greater and the population before extinction will be lowered if releases are started when the increment of increase is least. The increment of increase of a population and the factors determining the increment are important in determining plant capacity and cost of control. When the cost of the rearing plant, the cost of operation, and the number of generations required to reach extinction are considered, we appear to have an optimum size of

plant and rate of release: higher rates of release are costly and save little time. Sterilisation of the males in a natural population is a more effective method than the release of sterile populations if both males and females are killed or sterilised. The relative efficiency of different treatments of the two sexes in the field depends on the mating ability of the males, the proportion of the two sexes that survive treatment, and the fertility of the survivors. (Auth.)

1573 Maksymov, J.K. NEUE WEGE IN DER INSEKTENBEKÄMPFUNG. (New perspectives in insect control.) Schweiz. Z. Forstwes. 116, 3 (1965) 235-242. (In German, with French summary)

This paper describes the practical and experimental methods being used to fight annoying insects. Classic methods, such as biological control by Bacillus thuringiensis and the use of DDT (dichlorodiphenyltrichloroethane) insecticides, are reviewed. Emphasis is placed on the newer methods of chemosterilization and sexual attraction by synthetic hormones. Sterilisation by γ-rays from ^{60}Co is discussed. (From auth. summ. transl.)

1574 Mehrotra, K.N., Sethi, G.R. ADVANCES IN INSECT POPULATION CONTROL BY THE STERILE-MALE TECHNIQUE. J. scient. Ind. Res. 25 (1966) 539-543.

The history and basic principles of the sterile-male technique for the eradication of insect pests are described. A critical evaluation of various methods for induction of sterility in insects and the aspects of nutrition concerned with mass rearing of insects are discussed. A brief account of research being performed in different parts of the world on various aspects of the technique is given and future lines of work are indicated. (NSA 21: 1967, 22720)

1575 Shipp, E., Osborn, A.W. THE THEORETICAL ROLE OF PREDATORS IN STERILE-INSECT RELEASE PROGRAMS. Bull. ent. Soc. Am. 12, 2 (1966) 115-116.

The benefits derived from predators will be related to their effectiveness at different prey densities, the size and duration of natural population fluctuations, as well as the relative length of the life cycles of predator and prey species. Advantages gained through the efficient use of parasite or predator populations in eradication programmes based on releases of sterile insects may be summarized as follows: (1) the cost of some programmes may be reduced by the combination of these two factors and by elimination of sexing and handling procedures; (2) there may be an increase in the range of pests for which sterile-male release programmes are feasible. The decline of a naturally fluctuating population may be hastened, thus increasing the duration of the low-density period; (3) there is an additional safeguard in the availability of predator pressure when sterile releases cease. – The use of predators in sterile-male eradication programmes is being investigated in a study of sugarcane leafhoppers of the genus Perkinsiella. Increasing the effectiveness of Knipling's sterile-male eradication technique by the possible supplementation of both "flushing" and increased predator effectiveness is considered.

1576 Van Hoeck, F. NUCLEAR ENERGY IN AGRICULTURE AND THE FOOD INDUSTRY. Ass. Belge dev. pacif. energie atom. Bull. Inf. 8, 45/46 (1963) 58-63.

General survey. Some mention is made of insect sterilisation by irradiation.

See also:

467 Some applications of radioactive isotopes in ecological research. (Noordink, J.P.W., 1965)
905 Atomic energy in the control of insects. (Baccetti, B., 1962)
906 Studies on the inheritable variability of radiation of insects and the biological control of (?-) sterilized insects. (Chiang, J.J.H., 1965)
1118 Radiation sterilization in controlled insect pests. (Andreev, S.V. et al., 1967)
1134 The induction of dominant lethal mutations in insects by ionizing radiation and chemicals - as related to the sterile-male technique of insect control. (LaChance, L.E., 1967)
1135 Radiation-induced sterilization. (LaChange, L.E. et al., 1967)
1335 A cytological study of the effects of radiation on the development of the reproductive organs of two species of fruit flies: Dacus oleae and Ceratitis capitata. Report No. 7 (Final), December 20, 1962 - December 19, 1965. (Baccetti, B., 1962/1965)
1547 Towards better insect control. (Nelson, S.O., 1965)

1633 Can nuclear energy be used for the protection of cereal stores against insects? (Pesson, P., 1965)

1740 Waxed-paper laboratory cage for sterilization studies with the oriental fruit moth, Grapholitha molesta (Busck) (Lepidoptera: Tortricidae). (George, J.A. et al., 1964)

1758 Bibliographie concernant la lutte biologique. (Franz, J.M. et al., 1967)

1760 Information circular on Radiation Techniques and their Application to Insect Pests, No.7. (International Atomic Energy Agency, Vienna (Austria), 1966)

1770 Ionizing radiation in applied entomology. (Cadahia, D., 1966)

1789 Physical methods of insect control. (Watters, F.L., 1965)

1791 "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology, Gainesville, Fla., 4 Oct. - 26 Nov. 1965". (International Atomic Energy Agency, Vienna (Austria) et al., 1965)

2.4.2.1.1. Coleoptera

1577 Andreev, S.V., Martens, B.K., Molchanova, V.A., Saldan, L.N. RADIOSTERILIZATION IN THE FIGHT AGAINST INSECT PESTS. Vest. sel'.-khoz. Nauk No.1 (1967) 48-52. (In Russian)

The sterile-male technique, utilizing radiation, was tried on the bean weevil, Bruchus obtectus, the Colorado potato beetle, Leptinotarsa decemlineata, and the corn earworm, Heliothis armiger. Bean weevils and corn earworms were irradiated, using a ^{60}Co-source: 6000 or 8000 R, respectively, proved sterilizing doses. An x-ray unit was used on Leptinotarsa: 8000-10 000 R resulted in the complete sterilization of males. An investigation into the effect of different ratios of sterilized to non-sterile insects upon population density gave a population decrease down to 34% after introducing 20% of sterile males, compared with the control, and only 9% after 60% of sterile males. The optimal sterilizing doses ranged from 6000 to 10 000 R for the above-mentioned insects. A detailed analysis of the whole complex of conditions necessary for the successful application of the sterile-male technique shows that costs are lowest when it is applied to control insects whose complete life cycle takes place under field and barn conditions (e.g. for the pea and bean weevils). It is possible to achieve the total liquidation of such insects as early as in the third generation. The research report is preceded by a brief analysis of work on some of the main problems connected with this technique, e.g. the effect of γ-radiation on the reproductive organs, the determination of optimal sterilizing doses subject to the developmental stage considered, and the selection of economically important insects whose biological characteristics make the technique particularly appropriate.

1578 Chung, S.L., Lippold, P.C. COBALT-60 STERILIZATION STUDIES WITH THE EUROPEAN CHAFER. II. Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 109, at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Sterilisation doses for field and laboratory-reared beetles were determined. Sub-sterilising doses resulted in enhanced egg production with some crosses. Egg production was dependent on female-male ratios. Improved techniques for rearing and holding stages after treatment were developed. (Abstr.)

1579 Gilliland, F.R., Jr. MATING BEHAVIOR AND POPULATION DYNAMICS OF THE BOLL WEEVIL AS RELATED TO THE STERILE-MALE-TECHNIQUE OF INSECT CONTROL. Diss. Abstr. 28, 3 (1967) 1269-B - 1270-B.

These studies were conducted to investigate whether certain aspects of the mating behaviour and population dynamics of the boll weevil, Anthonomus grandis Boheman, would affect effective application of the sterile-male technique for the control and/or eradication of this pest. It appears that the female is primarily responsible for controlling mating frequency under normal field conditions. However, as population density increases, the influence of males in controlling mating frequency also increases. Results of alternate mating studies showed that when an equal number of matings with sterile and normal males occurred, both equally influenced overall egg-hatch. The initial mating in the sequence had little effect on overall egg-hatch, while the last mating prior to oviposition was most influential on subsequent egg viability. Only slight differences were noted between egg fertility from single and double matings, an indication that little additional sperm is transferred in the 2nd mating if it occurs within a few hours. The developmental diet of the males

did not influence subsequent mating competitiveness. In population dynamics and sterile-male-release* experiments, the peak number of 1st generation weevils were observed during the 5th week. Emergence of the 1st generation weevils was also indicated by the sharp weekly increase in the average rate of oviposition-punctured squares. The 2nd generation began during week seven and peaked during week eight. The rate of increase between generations was dependent upon the population density of the original population. Thus, the rate of increase from the overwintered to the F_1 generation was greater than that from the F_1 to the F_2 generation. The rate of increase per generation was only slightly inhibited by releases of sterile males. Shedding of squares following egg deposition was found to be due largely to the hatching of the egg and not just to the damage incurred in the act of oviposition. Terminal data indicated that the weekly releases of sterile males failed to achieve control. Failure of the tests was most likely due to the low ratio of sterile to normal males present. However, some inhibition of population buildup was observed, indicating possible future successes with this method of control. (From DA)

* apholate used here.

1580 Horber, E. MAIKÄFER GEGEN MAIKÄFER! EIN VERSUCH ZUR TILGUNG EINES ENGERLING-HERDES DES FELDMAIKÄFERS (Melolontha vulgaris Fabr.) MIT RÖNTGENBESTRAHLTEN MÄNNCHEN. (Cockchafer against cockchafer! An attempt to eradicate a larval population of M. melolontha (L.) (vulgaris F.) by the release of x-irradiated males.) Waldhygiene 6, 6 (1967) 161-170. (In German, with English summary)

A field trial is described to eradicate white grubs by means of irradiated males. During two flight periods, in 1959 and 1962, respectively, irradiated males were released over a 30-ha area A. Gradation in that area as well as in three control areas, C, continued to be checked since 1953. In 1959, for the 1st treatment, 6 ℓ of sterilised males were released over A, representing ~50% of the male population. White grub infestation sampled in grassland subsequently dropped to ~ 1/5 of that in the other areas. Reproduction rate remained < 1 in A only. Further reduction of the population in A to 1/10 of that in C was observed when the number of surviving cockchafers was estimated in spring 1962. The greatest mortality between 1959 and 1962 occurred in A. - In 1962, for the 2nd treatment, a total of 17 ℓ was released over A, representing 76-100% of the male population of A. Subsequent sampling showed complete eradication in A. Some reduction was also observed in B and C, resulting from drought in the whole region. - For the last flight period in 1965 no treatment was necessary since only a few cockchafers occurred in A, whereas their number had increased in C 1-3. Subsequent sampling of the white grub population confirmed complete eradication in A, and increases in C 1-3. The results are a demonstration that the sterile-male technique may be successfully applied to insects in an area which is not strictly isolated geographically, where the females of the pest mate several times, the artificial breeding in large quantities is not feasible because of a long developmental cycle, and the most voracious and destructive stages of the insect live hidden in the soil.

1581 Horber, E. USE OF ALTERNATIVE BIOLOGICAL CONTROL SCHEMES. p. 167-183 of "Proceedings of the FAO Symposium on Integrated Pest Control, Pt.2. Rome, Italy. 11-15 Oct. 1965". Rome, Food and Agriculture Organization of the United Nations. 1966. 183 p.

Among the topics discussed in this review are biogenetic control measures such as the use of ionizing radiation. (His own work on Melolontha vulgaris is quoted by the author, where small-scale field experiments with irradiated white grubs on grassland resulted in eradication.) The use of chemo-sterilants, antimetabolites, and alkylating agents is discussed. The use of selective agents is described; they are divided into attractants (sex attractants, attractants and arrestants associated with host plants), repellents, antifeeding compounds, and hormones (ecdysone, juvenile hormone, and competition and coordination between hormone activities).

1582 Jermy, T., Nagy, B. LABORATORY EXPERIMENTS TO CONTROL THE COCKCHAFER (Melolontha melolontha L.) BY THE STERILE MALE TECHNIQUE. Acta phytopath. hung. 2, 3 (1967) 211-217. (In English)

Cockchafer adults dug out from the soil just before emergence were irradiated with x- and γ-rays, respectively. The sterilising dose was found to be > 1.5 kR, 3 kR giving 98-100% sterility. x-rays and γ-rays showed the same sterilising effect at the dose rates used in the experiments (8.58 kR/min

for x-rays, 3 kR/h and 2.82 kR/h at 38 and 100 cm, respectively, for γ-rays). Feeding before irradiation seems not to affect sterilisation. Irradiated (3 kR) males were fully competitive with normal males in cage experiments. High locomotor activity of males was observed during irradiation even at 12°C. (Codling moth pupae showed the same reaction.) Longevity of cockchafer males was not shortened by irradiation. (From auth.)

See also:

1124 Sterilization of the male alfalfa weevil (Hypera postica: Curculionidae) by x-radiation. (Burgess, E.E. et al., 1966)

1320 Reproductive potential of the sweetpotato weevil after exposure to ionizing radiations. (Walker, J.R., 1966)

1340 Study on the sterilization and radiosensitivity of Chrysomela decemlineata Say by means of radioisotopes. (Cavalloro, R. et al., 1966/1967)

1569 Radiation-induced sterilization. (LaChance, L.E. et al., 1967)

2.4.2.1.2. Diptera

1583 Abdel-Malek, A.A., Tantawy, A.O., Wakid, A.M. STUDIES ON THE ERADICATION OF Anopheles pharoensis Theobald BY THE STERILE-MALE TECHNIQUE USING COBALT-60. I. BIOLOGICAL EFFECTS OF GAMMA RADIATION ON THE DIFFERENT DEVELOPMENTAL STAGES. J. econ. Ent. 59 (1966) 672-678.

Pupae of A. pharoensis Theobald were subjected to ^{60}Co γ-radiation from 500 R to 7000 R with 500 R increments, to study the biological effects of γ-rays on fitness components. The results indicate clearly that lifetime egg production increased significantly at lower doses (1000 R) with no significant effects at doses between 1500 and 2000 R, after which a highly significant decline was observed. Percentage of hatchability was greatly affected at all doses, falling below 1% at 5000 R, above which it remained constant. Percentages of pupation and emergence, sex ratio, and longevity of adults were not affected by irradiation; irradiated adults live longer than controls, though not significantly so. (Auth.)

1584 Abdel-Malek, A.A., Tantawy, A.O., Wakid, A.M. STUDIES ON THE ERADICATION OF Anopheles pharoensis BY THE STERILE-MALE TECHNIQUE USING COBALT-60. III. DETERMINATION OF THE STERILE DOSE AND ITS BIOLOGICAL EFFECTS ON DIFFERENT CHARACTERS RELATED TO "FITNESS" COMPONENTS. J. econ. Ent. 60, 1 (1967) 20-23.

Pupae of A. pharoensis Theobald were subjected to various doses of γ-rays from ^{60}Co, i.e. 10 000-13 000 R with 1000 R increments to study their effects on lifetime egg production, egg hatchability, and longevity of adult mosquitoes and to find the exact dose of γ-rays which may cause complete male sterility. The sterilizing dose (12 000 R) was used to investigate its adverse effects on pupae of different ages and the dose fractionation on the emerged adults. The results indicate clearly the adverse effects of high doses of γ-radiation on all characters studied except longevity of adult mosquitoes. A dose of 12 000 R caused complete sterility in both sexes. The results suggest that it was better to give the whole amount of the sterilization dosage at once rather than in fraction when pupae aged 15-20 h were used. (Auth.)

1585 Abdel-Malek, A.A., Tantawy, A.O., Wakid, A.M. STUDIES ON THE ERADICATION OF Anopheles pharoensis Theobald BY THE STERILE-MALE TECHNIQUE USING COBALT-60. VI. SPERM ACTIVITY IN MALES IRRADIATED WITH THE STERILIZING DOSE. J. econ. Ent. 60, 5 (1967) 1300-1302.

Matings between unirradiated female A. pharoensis Theobald and either normal or irradiated males (12 000 R) were carried out in breeding cages to investigate the sperm activity in γ-irradiated males. Normal or irradiated males, after complete matings with females, were replaced by irradiated or normal males and egg production and hatchability were recorded daily for the first 10 d. Replacing normal males by irradiated males caused a decrease in egg hatchability compared with the controls, but insemination by normal males did not nullify insemination by irradiated males. Sterilisation of males with 12 000 R γ-rays did not damage the sperm, as the sperm of irradiated males competed successfully with that from normal males, whether it was present in the spermatheca before or after

copulation with normal males. Delaying the mating of males for 5 d after irradiation did not restore viability of the sperm. (Auth.)

1586 Alley, D.A., Hightower, B.G. MATING BEHAVIOR OF THE SCREW-WORM FLY AS AFFECTED BY DIFFERENCES IN STRAIN AND SIZE. J. econ. Ent. 59, 6 (1966) 1499-1502.

The anticipated length of sterile-male release programmes such as those in progress in the southwestern United States and northern Mexico require constant evaluation of the effects of prolonged colonization and changes in rearing, irradiation, and release techniques on the mating behaviour of released male flies. Tests were conducted to evaluate some of the changes in mating behaviour that occur among colonized flies as laboratory adaptation increases with time in culture. The effects of differences in strains and size on the mating frequency of male screw-worm flies, Cochliomyia hominivorax (Coquerel), were studied in observed mating tests with a recently colonized (Mexican) and a laboratory-adapted (Florida) strain of flies. Large or small males of the Florida strain were obtained by rearing the flies on 2 different artificial media. Flies comparable in size to wild flies were reared in artificial wounds on sheep. Ancillary studies required sterilisation of the males by exposure to γ-irradiation. Differences in mating frequency among male flies that were attributable to strain disappeared after the Mexican flies had been colonized for 15 generations. However, differences in mating frequency between large and small Florida males persisted, regardless of the strain of the female flies, when the females were as large as flies in natural populations.

1587 Andrewartha, H.G., Monro, J., Richardson, N. FIELD EXPERIMENTS FOR CONTROL OR ELIMINATION OF LOCAL POPULATIONS OF THE QUEENSLAND FRUITFLY, Dacus tryoni: PART OF A CO-ORDINATED PROGRAMME OF INSECT CONTROL BY RADIATION. IAEA-R-234-F, International Atomic Energy Agency, Vienna (Austria). Apr. 1965, 3p.

During the spring of 1964 and the summer of 1964/65 twenty and one half million sterile pupae of the Queensland fruit fly, D. tryoni were distributed through two towns in western New South Wales. It was estimated that adults emerged from 63.8% of the pupae. About half of the adults would have been males. The results were measured by collecting, at fortnightly intervals, samples of fruit from all the trees bearing fruit ripe enough to be infested with maggots of the fruit fly. In one of the treated towns, where the overwintering population had already been reduced to an unusually low level by pre-treatment with insecticide during the previous summer, the wild population was exterminated soon after the experiment began and no sign of a fertile fruit fly was found in this area for the remainder of the experiment. In the other town where the initial wild population was greater and where the risk of re-infestation from neighbouring farms was also greater, the wild population was reduced almost to the point of extinction by late January and kept low for the duration of the experiment except for several minor re-infestations on the periphery of the treated area. In two comparable towns that were left untreated as controls the routine samples of ripe fruit contained the usual high proportion of fruits infested with maggots of D. tryoni throughout the summer. The pupae were reared at the University of Sydney, Department of Zoology, and sterilised at Lucas Heights. The mean weekly production of sterile pupae during eight months was 623 000, varying between 242 000 and 1 700 000.

1588 Baumhover, A.H. ERADICATION OF THE SCREWWORM FLY: AN AGENT OF MYIASIS. J. Am. med. Ass. 196 (1966) 240-248.

Development of the radiosterilised male technique for elimination of the screw-worm fly and other parasitic insects is reviewed. Eradication of the screw-worm from Curaçao by this method is considered from the point of view of mass production, sterilisation, release, and field evaluation of the project. For irradiation, a 480 Ci ^{60}Co unit was used for a 2000 square mile test with an initial dose rate varying from 788 to 910 R/min. To completely sterilise the screw-worms, 8000 R was delivered to pupae at 5.2-5.7 d of age. During a two-year campaign in Florida, 3.7 billion screw-worm pupae were produced. Twenty light aircraft were used to release flies over a max. area of 85 000 mi^2, and peak employment totalled 500. Irradiation studies showed that a sterilising dose of radiation could be administered to screw-worms without seriously affecting longevity or male competitiveness. Economic aspects of the programme are discussed. (NSA 21: 1967, 6746)

1589 Cohen, I., Nadel, D., Peleg, B.A., Kahan, R.S., Eisenberg, E. CONTROL OF THE MEDITERRANEAN FRUIT FLY (C. capitata Wied.) BY MASS IRRADIATION STERILISATION OF LABORATORY-BRED FLIES. p. 281 of "Research Laboratories Annual Report. For the Period January-December 1965", IA-1082, Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center. 363p.

Tests are being carried out under field conditions in three selected areas in order to evaluate the efficacy of fly control by the release of large numbers of flies bred at the Biological Control Institute, Rehovoth, and irradiated at the pupal stage, on the last day before emergence. The dose of 5-8 krad is used. Currently about 7 million pupae are irradiated and released per week. A total of 80 million pupae have been treated since the project was begun in April, 1965.

1590 Dale, P.S. PROSPECTS FOR CONTROL OF CODLING MOTH BY THE STERILE MALE TECHNIQUE. Orchard. N. Z. 38 (1965) 157.

In fruit-growing areas in New Zealand the codling moth population has been estimated at ~ 4 moths/tree/season, a number unlikely to be reduced further by the use of conventional insecticides. Three of the main apple-growing areas (Hawke's Bay, Nelson, and Central Otago) are naturally isolated from neighbouring areas by geographical barriers. Better rearing methods and detailed ecological studies are needed, but it would seem that the method has definite possibilities for New Zealand.

1591 Hoffman, R.A., Schmidt, C.D., Matter, J.J. LABORATORY AND FIELD STUDIES WITH ^{60}Co STERILIZED HORN FLIES. Bull. ent. Soc. Am. 12 (1966) 285. Abstr. 261, Presented at "Portland Meeting, Portland, Oreg., USA. 28 Nov.- 1 Dec. 1966".

^{60}Co irradiation of horn fly pupae resulted in high mortalities at sterilisation levels but newly emerged adults were sterilised by and survived 2000-5000 rad. Sterilised adults were released onto an isolated beef herd alone and in integrated insecticide—sterile-fly studies. The integrated tests provided the more promising horn fly control. (Abstr.)

1592 Huque, H., Ahmed, H. CONTROL OF FRUIT FLIES BY GAMMA RAYS. Fd Irrad. 6, 3 (1966) A28-A32.

The results of a preliminary study on Dacus cucurbitae in the Karachi area are reported. A standardized rearing technique has been developed and a laboratory culture maintained. Pupae were irradiated with γ-rays just prior to emergence. A dose of 7000-9000 R from a 1800-Ci ^{60}Co-source ensured sterilisation. The role of anoxia in the irradiation chamber is discussed.

1593 Huque, H., Malik, Q.R. CONTROL OF FRUIT FLIES Dacus zonarus Saunders BY GAMMA-RAYS. Int. J. appl. Radiat. Isotop. 18, 9 (1967) 658-661.

The min. dose for sterilising males of D. zonatus irradiated at the late pupal stage was found to be 7-9 kR, without involving any adverse effects on pupal survival, adult emergence, longevity or sexual aggressiveness. There was no decrease in oviposition when irradiated males were crossed with virgin females but the eggs did not hatch. - Females which emerged from treated pupae showed noticeably delayed oviposition period, and in some cases eggs failed to be produced. Adult longevity appeared to be normal. The sterile-male technique appears to hold great promise for Dacus zonatus.

1594 International Atomic Energy Agency, Vienna (Austria). INSECT ERADICATION AND PEST CONTROL GROUP. p. 64-66 of "IAEA Laboratory Activities. Third Report". Technical Report Series No. 55. 1966, 157 p. STI/DOC/10/55.

Ceratitis capitata was labelled by adding $MnCl_2$ to the larval food in concentrations of 10^{-4} to 10^{-3} g/g. Resulting 2-weeks-old adults were subjected to a flux density of 1.5×10^{13} n cm^{-2} sec^{-1} in the Seibersdorf reactor for 20 min at 2.5 MW. Improvements in rearing methods (automatic egg collection, cages, larval media) were developed, also a special device for dispersing adults from aeroplanes. - Some trial releases of the Medfly were made in three areas of Vienna in the (unfortunately unfavourable) summer of 1965, a low dose (5 krad) being given to 8-d-old pupae. No eggs were laid in probed apricots, and no larvae were detected in any of the summer fruit in places where standing populations persisted for up to three months. - Attempts are reported to set up self-sustaining colonies of tsetse flies. - A nearly satisfactory laboratory larval medium has been developed for the olive fly, and interest now focuses on devising an economic larval food.

1595 International Atomic Energy Agency, Vienna (Austria). THE MIDDLE EASTERN REGIONAL RADIOISOTOPE CENTRE FOR THE ARAB COUNTRIES, CAIRO. p. 135-151 of "IAEA Laboratory Activities. Third Report". Technical Reports Series No. 55. Vienna, International Atomic Energy Agency. 1966, 157p. STI/DOC/10/55.

The scientific programme is outlined. Among the projects already under study and given first priority is the eradication of Anopheles pharaoensis Theo. by the sterile-male technique using γ-irradiation from a ^{60}Co-source (p. 146-147). Field studies are under way. Similar studies on the eradication of Ceratitis capitata Wied. in the Arab region are part of a new project (p. 147-148).

1596 International Atomic Energy Agency, Vienna (Austria). INVESTIGATION OF CONTROL OF THE MEDITERRANEAN FRUIT FLY BY LIBERATION OF ADULT MALES IRRADIATED WITH GAMMA RAYS: PART OF A CO-ORDINATED PROGRAMME OF INSECT CONTROL BY USING RADIATION. Research Contract 193. p. 93-94 of "IAEA Research Contracts. Sixth Annual Report". Technical Reports Series No. 53. Vienna, International Atomic Energy Agency. 1966, 131p. STI/DOC/10/53.

Research Institution: Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA), San Salvador, El Salvador.
Principal scientific investigator: E. Morales.
Period of contract: 1 Mar. 1963 - 28 Feb. 1965.

Methods of mass rearing, γ-sterilisation, and field assessment of sterile fly release were basically similar to those used in other laboratories. To avoid damage of wings during the overcrowded field releases, the pupae were mixed with tropical almond leaves. The curled leaves keep the pupae from packing and provide extra perching sites where newly emerged adults can stay until their wings are inflated and hardened.

1597 International Atomic Energy Agency, Vienna (Austria). FIELD EXPERIMENTS FOR CONTROL OR ELIMINATION OF LOCAL POPULATIONS OF THE QUEENSLAND FRUIT-FLY, Dacus tryoni (Frogg): PART OF A CO-ORDINATED PROGRAMME OF INSECT CONTROL USING RADIATION. Research Contract 234. p. 99-100 of "IAEA Research Contracts. Sixth Annual Report". Technical Reports Series No. 53. Vienna, International Atomic Energy Agency. 1966, 131p. STI/DOC/10/53.

Research Institution: University of Adelaide, Department of Zoology, South Australia.
Principal scientific investigator: H. G. Andrewartha.
Period of contract: 1 Oct. 1963 - 30 Sep. 1965.

During the spring of 1964 and the summer of 1964/65, 20 million pupae were sterilised by γ-irradiation and distributed through two towns in western New South Wales. It was estimated that adults emerged from 64% of pupae: about half the adults were males. Two comparable towns were left untreated as controls. Results were measured by collecting, at fortnightly intervals, samples of fruit from all trees bearing fruit ripe enough to be infested with fly maggots. The primary objective of the project was achieved since it could be shown that the sterile-male technique could be used to control or perhaps to eliminate local populations of the Queensland fruit fly.

1598 Katiyar, K.P. DETERMINATION OF THE STERILIZATION DOSE OF THE MEDFLY WITH THE OIRSA Co-60 IRRADIATOR. p. 108-109 of "The Application of Nuclear Energy to Agriculture. Annual Report". Moh, C.C., Ed. NYO-2043-52, Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica). 1 Jul. 1967. 165p.

10 kR was found to reduce male fertility to 0.04%.

1599 Katiyar, K.P. p.110-111 of "The Application of Nuclear Energy to Agriculture. Annual Report". Moh, C.C., Ed. NYO-2043-52, Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica). 1 Jul. 1967, 165p.

A progress report on the cooperative project with OIRSA on Medfly control in Central America by sterile male releases.

1600 Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo (Egypt). ANNUAL REPORT, JANUARY 1, 1965 - DECEMBER 31, 1965. NP-16547. Jan. 1966, 38p.

Activities in the training of specialists in the application of radioisotopes in science, industry, agriculture, and medicine and in research using radioisotope techniques are reported. Progress on eradication of Anopheles pharoensis and Ceratitis capitata by radio-sterilisation technique is reported, amongst other studies. A list of 29 references to papers published on work performed at the centre is included.

1601 Nadel, D.J., Peleg, B.A. THE ATTRACTION OF FED AND STARVED MALES AND FEMALES OF THE MEDITERRANEAN FRUITFLY, Ceratitis capitata Wied., TO "TRIMEDLURE". Israel J. agric. Res. (Ktavim) 15, 2 (1965) 83-86.

Investigations in Israel on the influence of feeding on the attraction of C. capitata to trimedlure showed that starved females are attracted preferentially to yeast hydrolysate, whereas starved males are attracted to trimedlure. When no food was supplied, both newly emerged and sexually mature females were found to be attracted to trimedlure. The rate of attraction of females to this male lure increased in proportion to the extent of their starvation. Feeding on a mixture of yeast hydrolysate and sucrose (1:2) or sucrose alone abolished the attractiveness of trimedlure to females. This phenomenon may be useful in monitoring irradiated-fly releases. (From auth. summary)

1602 Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador (El Salvador). SUMMARY OF THE MEDFLY INVESTIGATION SECTION'S ACTIVITIES DURING THE PERIOD JANUARY-MARCH 1965. IAEA-R-193-F, International Atomic Energy Agency, Vienna (Austria). 1965, 13p.

Sterile fly releases continued in the pilot test area of Puntarenas. During this quarter small sterile releases were initiated in Jinotega and Corinto, Republic of Nicaragua, and in Boquete, Republic of Panama. Studies involving the establishment of parasites continued in central Costa Rica. Several experiments involving improvements in mass rearing techniques and sterile fly releases were conducted. Severe fungus infestation of the larval media was successfully controlled by certain treatments using tegocept and sodium benzoate.

1603 Parker, J.S. MEXICAN FRUIT FLY STERILE RELEASE PROGRAM. Bull. ent. Soc. Am. 13, 3 (1967) 203. Abstr. 349. Presented at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Sterilised Mexican fruit flies have been used in place of insecticides along the California-Arizona-Mexico border for the 4th year to prevent infestations from becoming established in the United States. More than 20 million flies are reared and sterilised at Monterrey, Mexico, and flown to the target area for release each year. (Abstr.)

1604 Price, M.A., Newton, W.H. THE SCREWWORM AND ITS CONTROL. SWest. Vet. 16, 1 (1962) 43-49.

Screw-worm control by the use of the sterile-male technique is discussed in detail. Chemical control is recommended with Co-Ral as a 5% dust, 0.25-0.5% spray, or 0.25% dip, ronnel as a 0.5% spray, 5% smear, or 2.5% aerosol spray, lindane as a 3% smear, or diphenylamine as a 35% smear. (CA 64: 1966, 18342d)

1605 Proverbs, M.D., Newton, J.R., Logan, D.M. ORCHARD ASSESSMENT OF THE STERILE MALE TECHNIQUE FOR CONTROL OF THE CODLING MOTH, Carpocapsa pomonella (L.) (LEPIDOPTERA: OLETHREUTIDAE). Can. Ent. 98, 1 (1966) 90-95.

Sterile male codling moths, exposed as pupae to 40 krad of γ-radiation and released in an abandoned 20-tree apple orchard for 3 yr, reduced the percentage of fruits injured by mature or almost mature 2nd-brood larvae from 4.94 to 0.05. Numbers of sterile males released, ratios of sterile to fertile males during peak emergence of 1st-brood moths, and numbers of overwintering larvae were: 1961 (3 DDT sprays applied) - 0, 0:1, 400; 1962 - 21300, 8:1, 957; 1963 - 67500, 21:1, 43; 1964 - 89200, 715:1, 6. (Auth.)

1606 Proverbs, M.D., Newton, J.R., Logan, D.M. AUTOCIDAL CONTROL OF THE CODLING MOTH BY RELEASE OF MALES AND FEMALES STERILIZED AS ADULTS BY GAMMA RADIATION. J. econ. Ent. 60, 5 (1967) 1302-1306.

Larval progeny of Carpocapsa pomonella (L.), was reduced 80% when adult moths, exposed to 48 krad in CO_2, were caged in the laboratory with untreated moths at a ratio of 15 irradiated males and 15 irradiated females to one untreated male and one untreated female. In an abandoned 2-ha apple orchard, release of 271 000 irradiated (50 krad) male and female moths in 1964, and 478 000 in 1965, reduced the numbers of apples injured by codling moth at harvest from approx. 60% in 1963 to 1.8% in 1964 and to 0.3% in 1965. (Auth.)

1607 Rai, K.S. FEASIBILITY OF THE STERILE-MALE TECHNIQUE FOR Culex fatigans CONTROL IN CEYLON. Bull. ent. Soc. Am. 12 (1966) 257. Abstr. 227, at "Portland Meeting. Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

Culex fatigans is the only known vector of Bancroftia filariasis in Ceylon. At the request of the International Atomic Energy Agency and the Government of Ceylon, the feasibility of controlling this species using the sterile-male technique was evaluated. Data on various aspects of the study were presented. (From abstr.)

1608 Riedel, M. ZUR BIOLOGIE, ZUCHT UND STERILISATION DER KOHLFLIEGE Phorbia brassicae Bouché, UNTER BESONDERER BERÜCKSICHTIGUNG IHRES VORKOMMENS IM RETTICHANBAU. (Study of the biology, breeding and sterilisation of the cabbage fly, Phorbia brassicae Bouché, with special reference to its occurrence in radish cultures.) Bayer. landw. Jb. 44, 4 (1967) 387-429. (In German)

Ph. brassicae proved highly sensitive to radiation. Doses of > 2 kR caused complete sterility in both sexes. The optimum pupal stage for irradiation proved to be during the last 4 d before adult emergence. Prior irradiation causes visible somatic injury (reduced longevity, inability to fly, rise in pupal mortality). Sexual competitiveness is only adequate if the dose is < 3 kR. At 2-2.5 kR full competitiveness of the sterilised males is ensured. Experiments in the field have shown the need for similar size of the irradiated males if they are to be equally competitive.

1609 Scherney, F., Haisch, A. ÜBER MASSENZUCHT UND STERILISATION DER MITTELMEERFRUCHTFLIEGE Ceratitis capitata Wied. (EIN BEITRAG ZUR AUTOZITMETHODE). [Study on mass breeding and sterilisation of the Mediterranean fruit fly Ceratitis capitata Wied. (A contribution to the autocidal technique.)] Bayer. landw. Jb. 44, 6 (1967) 748-756. (In German)

Sterilisation by ionizing radiation was preferred to chemosterilisation. A ^{137}Cs-source of 1100 Ci was available, giving relatively soft γ-radiation. A dose rate of 75 R/min was given. Doses of from 4000-15 000 R were tested, in steps of 1 000 R. The aim must be to find an optimal dose which will produce max. sterility and min. somatic injury. A dose of 15 000 R was used in field releases. Flight range determinations were carried out by means of releasing sterilised ^{32}P-labelled pupae which had been labelled as larvae. 8 000 pupae were labelled. The average range was 15 m, the max. 345 m within 10 d. - The application of the method to local control or eradication of the Medfly under prevailing conditions is considered feasible.

1610 Tantawy, A.O., Abdel-Malek, A.A., Wakid, A.M. STUDIES ON ERADICATION OF Anopheles pharoensis BY THE STERILE-MALE TECHNIQUE USING COBALT-60. II. INDUCED DOMINANT LETHALS IN THE IMMATURE STAGES. J. econ. Ent. 59, 6 (1966) 1392-1394.

An experiment was designed to study the percentage of induced dominant lethals in the immature stages of the F_1 generation of A. pharoensis Theobald, following irradiation of parental eggs or pupae. Doses from 500 R to 5000 R of γ-radiation with 500 R increments were used. The results indicate clearly that the percentage of induced dominant lethals in eggs of A. pharoensis irradiated by γ-rays increased linearly with increasing dose: 100% lethality in the F_1 generation appeared at 2000 R γ-rays. On the other hand, the results secured from parental pupae irradiated with γ-rays demonstrate that dominant lethals in the egg, larval, and pupal stages of F_1 offspring resulting from irradiated pupae are most effective during the egg stage followed by the larval stage; complete lethality was achieved at 4500 R and 5000 R, respectively. γ-rays showed no significant effects on the F_1 pupal stage, i.e. adults would emerge from most of the pupae in spite of high doses of γ-irradiation. (Auth.)

1611 Tantawy, A.O., Abdel-Malek, A.A., Wakid, A.M. STUDIES ON THE ERADICATION OF Anopheles pharoensis BY THE STERILE-MALE TECHNIQUE USING COBALT-60. IV. MATING BEHAVIOR AND ITS FREQUENCY IN THE STERILIZED MOSQUITOES. J. econ. Ent. 60, 1 (1967) 23-26.

Late 3rd-instar larvae from the laboratory colony were reared in Nile water containing 0.01, 0.05, 0.10, and 0.20 μCi ^{32}P/ml. Insects to be autoradiographed were subsequently placed on x-ray dental films for 7 d. Mating frequency was tested on 200 labelled larvae. Half of the resulting labelled pupae were irradiated with a 12 000 R dose of γ-rays (the sterilising dose). The adult males were then allowed to mate with non-radioactive normal females. It was possible to detect the radioactive semen of males reared in media containing 0.20 μ Ci/ml ^{32}P in the spermathecae of their mates. By this technique it was feasible to determine whether females could mate more than once. By examining the mating behaviour and mating frequency in males, it was found that irradiated males were as effective as normal males in inseminating normal virgin females. Laboratory males could inseminate either wild females or laboratory females as efficiently as wild males, if each was confined to the same number of females.

1612 Tantawy, A.O., Abdel-Malek, A.A., Wakid, A.M. STUDIES ON THE ERADICATION OF Anopheles pharoensis BY THE STERILE-MALE TECHNIQUE USING COBALT-60. V. MATING COMPETITIVENESS IN RADIOSTERILIZED MALES. J. econ. Ent. 60, 3 (1967) 696-699.

A study of mating competitiveness between sterilised males and normal males of A. pharoensis Theobald showed that males treated with 12 000 R (the sterilising dosage of γ-rays) were slightly less competitive than normal males when present in the population cages in ratios of 1:1:1 and 5:1:1 (irradiated males + normal males + normal females). But at ratios of 10:1:1 and 15:1:1, the competitiveness of the irradiated sterile males was increased. Normal males captured from nature as larvae and bred in the laboratory showed almost the same mating competitiveness as males from the laboratory colony. By replacing normal males with irradiated males in the normal population, egg hatchability showed a decrease as compared with their controls. Replacing irradiated males with normal males did not produce a decrease in egg hatchability. (Auth.)

1613 Wave, H.E., Henneberry, T.J. STERILE-MALE RELEASES CONTROL POPULATIONS OF Drosophila melanogaster * IN CAGE TESTS. J. econ. Ent. 60, 6 (1967) 1758-1759.

Laboratory tests were made at Beltsville with sterile males of Drosophila to determine the effectiveness of the sterile-male technique. In suppressing caged populations, γ-irradiation or feeding with apholate was used. Irradiated flies were exposed about 24 h before release to 16 kR of γ-radiation from a ^{60}Co source delivering about 320 R/min. All flies, irradiated or apholate-fed, were 4-5 d old when they were released. The two methods of sterilisation, at the indicated dosages, have been shown to produce no viable eggs when the treated males, at 1, 5, or 10 d of age, were mated to untreated females. 24 h after treatment, male flies exposed to 16 kR are as reproductively competitive as untreated males. In the first experiment, newly emerged, untreated virgin flies were sexed and 50 pairs placed in each cage. One cage received irradiated, another apholate-treated males. The initial releases of sterile males, made immediately after the untreated flies were introduced, were made at a ratio of 20 sterile to one untreated ♂ (1000/cage). The test lasted 57 d (about 4 generations). Temperatures during the test ranged from 17-30°C, with an overall average of 24°C. Additional releases of 3200 and 3000 apholate-treated ♂ each were made 10 and 28 d, respectively, after the start of the experiment. A final release of 1500 irradiated ♂ was made the 34th day. The fly population in the check cage increased noticeably during the first 17 d. Increases in the cages containing irradiated and apholate-sterilised males were not apparent until after 27 d. Then the number of larvae and pupae in the medium in the two cages of treated flies was markedly less than that in the check cages. After 57 d the fly population in the cage containing irradiated males was 93% less, and that in the cage containing the apholate-treated males 87% less than the population in the check cage. However, some flies in the two cages containing treated males produced viable eggs because of the long interval between releases, which permitted a small percentage of the newly emerged females to mate with fertile males. The 2nd experiment consisted of three cages, one receiving weekly releases of apholate-treated males; one receiving weekly releases of γ-irradiated males; and one a check, receiving no releases. All initial releases were based on a ratio of 20 sterile to 1 untreated ♂. The cages were initially infested with 20 untreated pairs, and the 1st releases of sterile males were made at the time of initial infestation with the untreated flies. Eight releases were made during the 56 d. Average daily temperatures ranged from 16-40°C, with an overall average of 25°C. In experiment 2 no reproduction occurred when apholate-treated males or irradiated males were released weekly in the cages.

* Diptera: Drosophilidae.

1614 Whitney, D. STERILE FLIES USED, ENEMY OF OLIVES SUBJECTED. Nat. Hist., N.Y. 75, 3 (1966) 30-35.

Popular illustrated article describing present efforts in Greece to apply the sterile release method to the olive fly, Dacus oleae.

1615 Anonymous. SCREWWORMS ERADICATED FROM U.S. Agric. Res., Wash. 15, 1 (1966) 7.

1616 Anonymous. ATOMIC WAR ON INSECTS INTENSIFIED. Int. atom. Energy Ag. Bull. 9, 3 (1967) 8-13.

The release of sterilised Ceratitis capitata on Capri is the 1st full-scale trial in Europe of the sterile-male technique. Improved rearing techniques allow the production of Medfly at a food and labour cost of ~ $7-10/million flies. A fly cannon was developed through which paper bags containing the flies and wood wool are dropped, ripped open, and released below the slip stream of the aircraft, enabling the flies better to survive the fall and to disperse quickly. Pioneering work was done by the Biological Control Institute of the Citrus Marketing Board of Israel and the Agency's Entomology Laboratory in Seibersdorf, Austria. - A mainland campaign against the Medfly is being carried out in Central America by the IAEA/FAO Joint Division of Atomic Energy in Agriculture, to demonstrate over an area of 60 000 acres the feasibility of eradicating the pest with the help of radiation. Other types of pests (livestock) studied for possible control by the sterile-male technique are indicated.

1617 Anonymous. ATOMIC ENERGY IN LATIN AMERICA. Int. atom. Energy Ag. Bull. 9, 3 (1967) 15-19.

In entomology, the research has consisted chiefly of developing and promoting the application of the sterile-male technique in insect control. The work is being put to good use in the United Nations Development Programme Special Fund project for the eradication of Ceratitis capitata in Central America, where Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama are working together under the technical guidance of the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture.

See also:

14 Insect control. I. Tagging the fruit fly Ceratitis capitata Wied. with radioactive phosphorus for the sterile male technique. (Raimundo, A.C. et al., 1965)

1119 Application of radioactive isotopes to the investigation of methods for the biological control of pests. III. The obtaining of sterile males of C. capitata by irradiation of the pupae with γ-rays. (Arroyo, M. et al., 1965)

1120 Application of radioactive isotopes to the investigation of methods for the biological control of pests. IV. The effects of γ-radiation on C. capitata when the dose of irradiation is fractionated. (Arroyo, M. et al., 1965)

1146 On the radioactive isotope utilization for forest protection. (Popa, A. et al., 1965)

1354 Stérilisation de la mouche méditerranéenne des fruits, Ceratitis capitata Wied., par irradiation des pupes aux rayons gamma. (Féron, M., 1966)

1366 Sterilization of onion maggots by irradiation with cesium-137. (McClanahan, R.J. et al., 1966)

1431 Radiation sterilization of the black blow fly. (Bushland, R.C., 1966)

1504 Effect of selection on whaxy: an autosomal dominant mutation in the screw-worm fly with recessive lethal effects. (LaChance, L.E. et al., 1965)

1563 Sterile technique - principles involved, current application, limitations, and future application. (Knipling, E.F., 1967)

1569 Radiation-induced sterilization. (LaChance, L.E. et al., 1967)

1571 Integrating control of pest populations in large areas. (Lawson, F.R., 1966)

1679 Control of Queensland fruit fly. (O'Loughlin, G.T., 1964)

1702 Economic aspects of the food irradiation programme in Israel. (Lapidot, M. et al., 1966)

2.4.2.1.3. Lepidoptera

1618 Azaryan, G.K., Babayan, V.V., Vasilyan, V.V., Mkrtumyan, K.L. PROSPECTIVE USE OF RADIATION TO CONTROL THE HOLLYHOCK SEED MOTH*(LEPIDOPTERA, GELECHIIDAE). Ent. Rev. 44, 4 (1965) 449-453. Ént. Obozr. 44 (1965) 762-769. (in Russian)

The biological effect of x-irradiation of the hollyhock seed moth is dependent on the age of the irradiated pupae for the dosages employed. Pupae 1-2 d old are the most sensitive to radiation. Moths obtained from these pupae lay single eggs or are sterile. The greatest biological effect is obtained by irradiating 1-2 d old pupae with a radiation dose of 5 000 R; the sterility of the moths reaches 100% in the combination of irradiated male plus non-irradiated female. The radiosensitivity of the pupae is approximately the same for the summer and wintering generations. The biological effect is higher for a single radiation dose. Radiation of this type yields the largest number of externally normal moths and the least number of fertile moths. The egg laying period is far shorter for moths obtained from irradiated pupae than for those from nonirradiated pupae. Life span is approximately the same for moths from irradiated and nonirradiated pupae and is not affected either by radiation dose or by the age of the pupae at the time of irradiation. (tr-Auth.)

* Pectinophora malvella Hb.

1619 Madsen, H.F. STERILE MOTHS IN CANADA - BEWILDERED, BUT EFFECTIVE. West. Fruit Grow. 19, 5 (1965) 15-16.

1620 Madsen, H.F., Downing, R.S. CODLING MOTH CONTROL. Pesticide Prog. 5, 3 (1967) 61-62. Also presented at "41st Annual Meeting of the Western Cooperative Spray Project, Portland, Oreg., USA, 11-13 Jan. 1967".

Results of release of sterile moths in a commercial orchard were reported successful from both Summerland, B.C., and Yakima, Washington. Both laboratories have found that it is not necessary to separate the sexes, and that release of sterilised mixed sexes gives results equal to release of sterile males alone. The main difference in techniques between the two Stations is that the moths are sterilised by γ-radiation at Summerland and by chemosterilants at Yakima. There is some evidence that moths rendered sterile by chemosterilants are not as long-lived as those sterilised by γ-radiation. An additional complication with chemosterilants is the variability of supplies which requires constant bioassay.

1621 Walker, D.W. ANNUAL REPORT 1965. Sugarcane borer control project. p. 157-159 of "Annual Report, 1965". PRNC-82, Puerto Rico Nuclear Center, Mayaguez. 225p.

Work on the suitability of Diatraea saccharalis (Fab.) for sterilisation by γ-radiation was started in 1963. The sterilising dose for adults of both sexes is 30 krad. Egg hatchability only, not egg number, is affected even at 60 krad. Behavioural changes in males irradiated with 100 krad did not prevent mating. Males irradiated at 2-4 krad mated sooner than non-irradiated males. Optimum ratios and rearing methods are also being studied. The borer usually mates more than once.

See also:

1127 Radiation sterilization studies on the tobacco budworm, Heliothis virescens Fab. (Flint, H.M., 1966)
1145 Sexual sterilization in the fight against codling moth in apple. (Petrushova, N.I., 1967)
1148 Exploratory studies on frequency of copulation in Prodenia litura F. (Lepidoptera: Noctuidae). (Shazli, A., 1963)
1156 Radiation-induced sterility for population control of the sugarcane borer (Diatraea saccharalis) in Puerto Rico. (Walker, D.W., 1966)
1307 Laboratory and field cage studies of the effects of gamma radiation on codling moths. (Hathaway, D.O., 1966)
1355 Gamma irradiation of pupae of the tobacco budworm. (Flint, H.M. et al., 1967)
1569 Radiation-induced sterilization. (LaChance, L.E. et al., 1967)
1577 Radiosterilization in the fight against insect pests. (Andreev, S.V. et al., 1967)
1688 Puerto Rico Nuclear Center. Its principal irradiation facilities and scientific program. (Rushford, F.E., 1967)

2.4.2.1.4. Hemiptera

See:

1144 Biology and radiation sterilization of sugar cane leafhopper. (Osborn, A.W. et al., 1966)
1149 Radiation sterilization of sugar-cane leafhoppers of the family Delphacidae. (Shipp, E. et al., 1966)

2.4.2.1.5. Acarina

1622 Galun, R., Warburg, M., Avivi, A. STUDIES ON THE APPLICATION OF THE STERILITY METHOD IN THE TICK Ornithodoros tholozani. Entomologia exp. appl. 10, 2 (1967) 143-152.

The tick is an important vector of human relapsing fever in Israel, and is also found in Jordan, Iran, Iraq, Syria, Cyprus, Turkey, and the Caucasus. In the Middle East the tick occurs as isolated populations in caves (from several hundred to many thousands) and old ruins. A method for the application of the sterile-male technique in O. tholozani is described, and its practicality discussed. The project is considered to be economical in spite of the long period involved before complete eradication could be achieved. Releases would be required every six months. Techniques for rearing large numbers (10 000-15 000 annually) on rats, and feeding through artificial membranes are given. A ^{60}Co-source emitting 7700 R/min was used. Nymphs are prevented from moulting at ≥ 2000 R if exposed before feeding. Both sexes emerging from nymphs irradiated by > 2000 R, two weeks after feeding, are sterile. These males are not competitive due to lack of sperm. Females become sterile after irradiation by > 2000 R, whereas males require 16 000 R in order to induce 99% dominant lethality. They are effective in competing with normal males.

See also:

1267 Effects of gamma radiation and chemosterilants on the cattle tick, Boophilus microplus. (Kitaoka, S. et al., 1967)

2.4.2.2. Overloading Resources

1623 Monro, J. POPULATION FLUSHING WITH SEXUALLY STERILE INSECTS. Science, N.Y. 151, 3717 (1966) 1536-1538.

In theory, populations of animals can be displaced by overloading a resource with introduced sterile animals. The theory was tested on natural populations of the Queensland fruit fly Dacus tryoni Frogg. The sterile flies were reared at 25°C and 8-d-old pupae sterilised with 6000 rad of γ-rays (^{60}Co). After emergence they were held for 4 d, fed for 2 d on sucrose containing ^{32}P ($NaH_2P^*O_4$) at a concentration of 100 μCi/g sugar, and then released into the treated populations. Three of four treated populations declined sharply within 2 d after sterile flies had been introduced. This procedure may be useful both as a tool in experimental ecology and as a means of controlling pests.

See also:

1558 Genetic weapons. Population replacement, induced sterility, or the introduction of deleterious genes - are all promising biological methods of fighting disease-carrying insects. (Collins, P., 1964)

2.4.3. Infestation and Countermeasures

2.4.3.1. Stored Products

1624 Akamine, E.K., Wong, T.F. EXTENDING THE SHELF LIFE OF PAPAYAS WITH GAMMA IRRADIATION. Hawaii Fm. Sci. 15, 1 (1966) 4-6.

Most of the papayas shipped out of Hawaii are hot-water treated to control decay and then fumigated to meet official disinfestation requirements (fruit fly control). The merit of the irradiation treatment in terms of shelf-life extension was judged objectively against that of fumigation treatment. The results of a representative experiment are shown in a table, in terms of storage decay, overall firmness and delay in senescence. In general, the salable life of the irradiated fruits was ‡ 3 days greater than that of the fumigated fruit. The irradiation dose was 75 krad. Irradiation as a quarantine measure has not yet been approved.

1625 Anonymous. THE DEFENSE DEPARTMENT IS ON ITS THIRD TEST PROCUREMENT OF IRRADIATED FOOD. Nucleonics Week 8, 24, June 15 (1967) 7.

"Requests for proposals went out last Friday for 131 500 lb of canned wheat flour, treated with a disinfestation γ-dose of 30-50 000 rad. Although some 60 irradiation companies and millers were solicited directly, other companies may propose, by June 19, to the Subsistence Regional Headquarters, Chicago, of the Defense Personnel Support Center. A spokesman for the Center said it hopes to award two parallel contracts, possibly to two teams of irradiation firms and millers. The military previously made production-test procurements of radiation-sterilized canned bacon and fresh potatoes treated with a low γ-dose to inhibit sprouting. . . The irradiated wheat contracts, which should be awarded by July 1, call for deliveries of varying amounts by late August, to Ft. Leonard Wood, Mo.; Camp Lejeune, N.C.; the Naval Supply Center, Norfolk, Va.; and the Defense Depot, Mechanicsburg, Pa. The military's food-irradiation program advanced on another front last week, with Food & Drug Administration approval of the Army's two-year-old petition for use of 4 flexible packaging materials with Co and Cs irradiation. . ."

1626 Brownell, L., Horne, T. IRRADIATION SHIP WOULD ELIMINATE GRAIN LOSS TO INSECTS IN TROPICS. Nucleonics 19, 6 (1961) 88-89.

A specially constructed grain irradiator ship is envisaged, with a 100 000 Ci ^{60}Co-source. Touring the world, it would call at ports where there was the greatest need, in order to irradiate grain supplies so as to rid them of both insects and insect eggs before they are put into storage.

1627 Daget, J. INSECT INFECTION OF AFRICAN DRIED OR SMOKED FISH AND THE POSSIBILITY OF ITS CONTROL BY IRRADIATION. p. 73-83 of "Application of Food Irradiation in Developing Countries". Technical Reports Series No.54. Vienna, International Atomic Energy Agency. 1966, 183p. STI/DOC/10/54.

Most fishing interests in the interior of Africa find it impossible to arrange the transport of fresh fish from the fishing grounds to the centres of consumption and storage. Moreover, resort to deep-freezing or simple refrigeration is impossible or too expensive. It is therefore necessary to dry or smoke, on the spot, all fish which is not immediately consumed by the local population. Drying and smoking offer many advantages in the developing countries, including low preparation costs, high nutritional value for low weight, and preservation and transport facilities. However, the dried or smoked fish is attacked by insects of the genera Dermestes and Necrobia and the damage is all the more serious since the fish is stored in large quantities. Chemical methods of disinsectization involve serious disadvantages. An attractive solution appears to be irradiation, which leads to the death or sterilization of the insects and which can be employed when the fish is already packed in hermetically sealed containers. (Auth.)

1628 Dobrovsky, T.M. ADVANCES IN STORAGE TECHNOLOGY WITH SPECIAL REFERENCE TO THE TROPICS. p. 63-68 of "Congress on the Protection of Tropical Crops. Proceedings. Marseille, France, 23-27 Mar. 1965". Marseille, Chambre Comm. Ind. 1965, 998p.

Review of the extent of damage caused by insects to stored food products and their control (by chemicals, natural enemies, and exposure to low temperatures or radiation) and discussion of storage techniques.

1629 Dockal, J., Kolín, J., Blazek, J. CONTROL AND STERILIZATION OF PESTS OF GRAIN STORAGES BY GAMMA RAYS. Ochr. Rost. No.3 (1965) 15-20. (In Czech)

1630 Goldblith, S.A. POSSIBLE APPLICATIONS TO FOOD OF IONIZING AND NONIONIZING RADIATIONS. J. Am. diet. Ass. 51 (1967) 233-237.

Development of processes utilising ionizing and microwave irradiation for food preservation is reviewed. In programmes investigating the use of ionizing radiation, the foods of greatest interest are: fish; shellfish; vegetables and fruits; poultry and eggs; and grains and potatoes. Studies with these foods are described. Relatively low doses (30 000 rad) are effective in destroying the insects that are important economic pests in grain.

1631 Goosens, H.J. LATEST APPROACHES TO FLOUR MILL PEST CONTROL. Fd Engng 36 (1964) 102-103.

Recent approval has been given to "gamma radiating" wheat and flour for insect control. "Gammas" from sources with max. energy not exceeding 2.2 MeV provide a safe-use absorbed dose of 20 000 - 50 000 rad. This insect control technique is effective, and millers don't oppose the issuance of these regulations. However, they have seriously studied this technique and feel, at this time, that there is insufficient data to guarantee γ-radiation not having an adverse effect on the baking quality of the treated flour or wheat. (Battelle Geneva Card-File)

1632 Hossain, M.M., De, H.N., Choudhury, S.U., Nabi, N. PAEC-CSIR JOINT PROJECT ON RICE IRRADIATION: TASTE PANEL REPORT ON ORGANOLEPTIC TESTS. AECD-RB-1, Atomic Energy Centre, Dacca, (Pakistan). Radiobiology Div. May 1966, 8p.

Exposure of stored rice to a dose of 16 000 R of ^{60}Co γ-radiation was found to kill insect pests and their eggs. Results are reported from a taste-panel evaluation of the flavour, texture, taste, and colour of cooked irradiated and control rice. It was concluded that radiation treatment causes no undesirable changes in the organoleptic properties of rice. (NSA 21: 1967, 20453)

1633 Pesson, P. CAN NUCLEAR ENERGY BE USED FOR THE PROTECTION OF CEREAL STORES AGAINST INSECTS? Inf. Doc. Agric. No.2 (1965) 1-12. (In French)

Efforts to destroy the cattle fly in Florida using radiation sources are reviewed. The conditions under which sterilisation of the male can be applicable to insect pests in cereal stores are defined. Hazards from the use of radiation are summarized. (NSA 21: 1967, 9042)

1634 Quartermaster Research and Engineering Center, Natick, Mass. PRESERVATION OF FOOD BY LOW-DOSE IONIZING ENERGY. AD-260894. Jan. 1961, 171p.

A review is presented of the current status of investigations on the radiation processing of foods. The fact that radiation processing of cereal grains, cereal products, and military ration components destroys adult insects, larvae, and eggs of insect pests that infest these foods is mentioned. No radioactivity has been induced in food products by high radiation doses. Extensive studies have shown that radiation processing has no effect on the wholesomeness of foods. The economic feasibility and potentialities of the radiation processing of foods are discussed.

1635 Steiner, L.F. GAMMA IRRADIATION FOR DISINFESTATION OF EXPORT FRUITS AND VEGETABLES. Hawaii Fm Sci. 15, 1 (1966) 11-12.

γ-irradiation at dosages of not less than 21 krad can be used in lieu of ethylene dibromide and methyl bromide fumigation, or vapour heat treatment to destroy the ability of dangerous pests in Hawaii fruits and vegetables to reproduce, and thus permit immediate export of the commodity. Adoption of the method must await final approval by the US Food and Drug Administration and of mainland quarantine officials, both State and Federal. - The mango weevil lives from young larva to adult within the seeds. Irradiated mangoes could carry live adults to the mainland. If a min. dose of ~25 krad is required most of the adults in the treated fruit will weaken and die without escaping from the seed. Any that survive would be sterile. - Some earlier pioneering work, and existing facilities and possibilities are reviewed briefly.

See also:

1436 Study of the irradiation tolerance of some destructive storehouse insects and technical and economic aspects of insect destruction by irradiation. (Farkas, J., 1965)
1640 Grain irradiation plant. (Anonymous, 1967)
1641 Lockhead-Georgia and the Hawaii development irradiator are winners. (Anonymous, 1967)
1645 The world's first large-scale continuous grain irradiation plant, Iskenderun, Turkey. (Anonymous, 1967)
1651 Design of the world's first industrial-scale grain-irradiation facility. (Carden, J.E., 1967)
1664 Radiation preservation of several fresh fruits and vegetables. (Hayakawa, A. et al., 1964)
1668 Food irradiation research and pilot facilities in operation or planned in India. (Kumta, U.S. et al., 1966)
1670 Control of the Queensland fruit fly by gamma irradiation. (MacFarlane, J.J., 1966)
1671 Potential role of radiation in alleviating some world food problems. (MacQueen, K.F., 1967)
1672 Conceptual designs for Hawaiian irradiator and quarantine demonstration irradiators. (Manowitz, B. et al., 1963)
1676 Recent advances in food irradiation research in Japan. (Matsuyama, A., 1966)
1678 Applications of intense radiation sources to biosynthetic food and medicaments. Part III. (Mouton, R., 1964)
1682 Hawaii development irradiator - a new tool in tropical fruit processing. (Otagaki, K.K., 1967)
1683 Irradiation of grain and potatoes. (Powers, J.J., 1967)
1684 L'effort belge en matière d'irradiation des aliments. (Proost, M., 1965)
1686 Gamma irradiation of grain and other reserves for sterilizing and exterminating pests. (Rukavishnikov, B.I., 1964)
1689 Gamma-ray attenuation coefficients of grains and forages. (Ruwe, D.M. et al., 1966)
1690 Food irradiation in Australia. (Scott, W.J., 1962)
1691 Prospects and needs for radiation disinfestation of packed fruits and vegetables. (Talhouk, A.S., 1966)
1693 x-Ray irradiation effects on storehouse destructive insects. (Török, G. et al., 1959)
1694 ibid.
1699 Effects of gamma irradiation on the longevity and fertility of five species of stored-product insects. (Watters, F.L., 1966)
1701 Economics of grain irradiation. (Baines, B.D. et al., 1966)
1702 Economic aspects of the food irradiation programme in Israel. (Lapidot, M. et al., 1966)
1751 Rice weevil biology as affected by grain storage conditions. (Russel, M.P., 1966)

2.4.3.2. Disinfestation Measures (Sources. Conveyor Systems. Etc.)

1636 Akamine, E.K., Buddenhagen, I., Brewbaker, J.L., Hilker, D. DOSIMETRY, TOLERANCE, AND SHELF LIFE EXTENSION RELATED TO DISINFESTATION OF FRUITS AND VEGETABLES BY GAMMA IRRADIATION. June 1, 1965 - May 31, 1966. UH-235P5-2, Hawaii Univ., Honolulu. Coll. of Tropical Agriculture. Sep. 1966, 106p.

Food irradiation studies using the Hawaii Research Irradiator are reported. Three commodities have been studied in great detail: the papaya, mango, and pineapple. Evidence obtained for each fruit attests to the biological feasibility of γ-irradiation for insect disinfestation. Associated studies suggest possible applications of γ-irradiation in commodity treatments of ginger, sweet potatoes, and even of Hawaiian fishcake, while its successful application for disinfestation of tangerines and avocadoes appears unlikely. Dosimetry studies were extended to include dose-response patterns when the central chamber was filled with water or papaya juice. (NSA 21: 1967, 4892)

1637 Andreev, S.V., Martens, B.K. CALCULATION OF DOSE DISTRIBUTION IN A GRAIN GAMMA IRRADIATOR AND DETERMINATION OF ITS BASIC PARAMETERS FOR THE "DISINSECTION" FLOW-LINE METHOD. Radiobiologiya 5, 4 (1965) 605-611. (In Russian)

Use of the flowline method for disinfestation ensures greater economy and permits the employment of radiation sources of lower activity than would otherwise be necessary. Formulae including tabulated coefficients are derived for a grain irradiator of such a type.

1638 Anonymous. PROGRESS OF FOOD IRRADIATION WORK AND PROGRAMMES IN O.E.C.D. MEMBER COUNTRIES. Fd Irrad. 5, 4 (1965) A2-A18.

The status of research and developmental studies on food irradiation in 1965 is summarized for Austria, Belgium, Canada, Denmark, France, German Federal Republic, Italy, The Netherlands, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Research programmes include studies on toxicity and nutritional value of irradiated foods. Developmental studies include various means of quality improvement, methods of extending storage life, and public acceptance or irradiated foods. Foods cleared by the U.S. Food and Drug Administration include wheat and wheat products, bacon, white potatoes, and packaging materials. Foods under intensive investigation include chicken, pork, luncheon meats, pre-cooked meat dishes, fish and other marine foods, onions, carrots, tomatoes, dehydrated vegetables, apples, strawberries, sweet cherries, raspberries, peaches, grapes, bananas, and tropical fruits such as papayas and mangoes. Related studies include studies on the radiosensitivity of certain bacteria involved in food poisoning, such as Clostridium botulinum and salmonellae, and the control of insect pests that infest foods by irradiation. (NSA 20: 1966, 708)

1639 Anonymous. TWO COBALT IRRADIATORS FOR A FOOD-TREATMENT LAB AT INDIA'S TROMBAY ATOMIC ENERGY ESTABLISHMENT.... Nucleonics Week 7, 22 (1966) 7.

"...will be supplied by Canada under the Colombo Commonwealth aid plan. They include a 100 000-Ci package irradiator, capable of treating about 100 lb/h at 0,5 Mrad, and a portable 27 800-Ci device that can handle 500 lb of grain/h at 15 krad. The irradiators are valued at $290 000 and will be delivered by Atomic Energy of Canada Ltd.'s Commercial Products Div."

1640 Anonymous. GRAIN IRRADIATION PLANT. Engineering, Lond. 223 (1967) 97-98.

The first full-scale application of radiation from a ^{60}Co source for insect disinfestation of grain has been installed in Turkey. Specifications of this irradiation plant that is designed to treat wheat, barley, rye, and maize at rates up to 50 t/h, with a dose sufficient to sterilize the insects in the grain are outlined. With the initial loading of 163 000 Ci of ^{60}Co the plant can continuously treat grain at a rate of 30 t/h. The grain irradiation facilities and the process used are described. Safety features and economic aspects of grain irradiation are also discussed. (NSA 21: 1967, 16552)

1641 Anonymous. LOCKHEED-GEORGIA AND THE HAWAII DEVELOPMENT IRRADIATOR ARE WINNERS Nucleonics Week 8, 27, July 6 (1967) 5.

on the irradiation side in the Defense Dept.'s test procurement of 131 500 lb of γ-ray disinfested wheat flour.* Prime contracts went to Helix Milling Co., Portland, Oreg., bidding with Lockhead, and Hawaiian Flour Mills of Honolulu, whose subcontractor will be the AEC-State of Hawaii experimental irradiator. The $500 000 facility coincidentally was dedicated just last Monday, but has been operational for some weeks. The flour contract is its first non-AEC commitment. Seven milling companies bid on the DOD procurement contract. Deliveries of the canned flour will begin next month to four Defense installations. (Cited verbatim)

* See 1639.

1642 Anonymous. A 150 000 CURIE CESIUM IRRADIATOR WILL BEGIN TOURING THE COUNTRY.... Nucleonics Week 7, 20 (1966) 7.

... late this year under the auspices of the AEC Div. of Isotopes Development. By far the largest ^{137}Cs unit available in the U.S., it is intended primarily for use by food packers and processors to acquaint them with the potential of γ-radiation preservation techniques. The 18 ton irradiator is being designed for AEC by Vitro Engineering Co. Bids for fabrication will be sought by DID next month. Use of the irradiator and the services of an AEC-trained operator will be offered free of charge to qualified organizations whose demonstration proposals will be formally solicited later this year. DID will engage an outside firm to handle the demonstration tour. Bids for this service will be sought by New York Operations. DID has only recently stepped up food-treatment research with

^{137}Cs, to supplement its extensive work with ^{60}Co. Brookhaven National Lab is now doing comparability tests between ^{137}Cs and ^{60}Co in preparation for the mobile irradiator (NU Wk, 23 Dec '65, 4). The cesium unit will have two 14 × 18 × 7-in. irradiation cans. At dosages of 200 rad, it can process about 100 lb/h at a product density of 0.3 and 250 lb/h with a density of 1.0. - Meanwhile, AEC'S Mobile Gamma Irradiator (NU Wk, 13 May '65, 7; 5 May '66, 7) arrived this week at the Davis campus of the Univ. of California. The university will operate the experimental fruit-irradiator under contract to AEC. (Cited verbatim)

1643 Anonymous. 100 000 CURIES OF COBALT FOR THE LARGE GRAIN IRRADIATOR IN TURKEY.... Nucleonics Week 7, 51 (1966) 9-10.

... are on their way from Harwell, England. The prototype plant, designed to hold 170 000 Ci and to process 50 t/h of maize, barley or rye, is located in Iskenderun. The $1.89 million project received $720 000 from the U.N. Special Fund (now known as the Development Program) and its construction was administered by the International Atomic Energy Agency. Nuclear Chemical Plant Ltd. of Britain won the contract to design and build the plant over stiff international competition (NU Wk, 10 Feb. '66, 7). The disinfestation plant is owned by the Turkish firm of Toprak Mahsulleri Ofisio, but its non-U.N. financing came from the Turkish government. (Cited verbatim)

1644 Anonymous. LOW DOSE ELECTRON BEAM RADIATION FOR TREATMENT OF FOOD FOR INSECT CONTROL IN WHEAT AND WHEAT FLOUR. NOTICE OF PROPOSED RULE MAKING. Fedl Reg. 31, 39 (1966) 3196.

1645 Anonymous. THE WORLD'S FIRST LARGE-SCALE CONTINUOUS GRAIN IRRADIATION PLANT, ISKENDERUN, TURKEY. Atom 124 (1967) 27-30.

A ^{60}Co source is used. Designed to treat 30 t wheat/h, with an absorbed radiation dose of 16 000 rad, its max. handling capcity is 50 t of wheat/h, and barley, rye and maize can also be treated. The plant could accommodate 360 000 Ci instead of the present 200 000 Ci of ^{60}Co. The irradiation facility comprises a concrete tower, with the irradiation plant at a low level, and two 125-t feed hoppers at high level, with a covered way connecting the existing silo installation. The feed hoppers are supplied by a system of chutes, sieves and conveyors from the existing plant, and appropriate conveying equipment returns the irradiated grain to the silo installation. Details of the source, cooling, safety aspects, and processing costs are given. Minimum costs for a Co-plant are 0.12 $/t and for a 3 MeV Dynamition installation 0.06 $/t. These costs correspond to throughputs of 150 and 400 t/h, respectively, for 6000 h of plant operation per year at these throughputs. Grain flow is controlled by annular flow channels and the rotating flow regulator. A variable speed drive mechanism is used. The building design is discussed.

1646 Anonymous. NEW GRAIN IRRADIATOR. Agric. Res., Wash. 15, 12 (1967) 11.

1647 Balock, J.W., Burditt, A.K., Jr., Seo, S.T., Akamine, E.K. GAMMA RADIATION AS A QUARANTINE TREATMENT FOR HAWAIIAN FRUIT FLIES. J. econ. Ent. 59, 1 (1966) 202-204.

γ-rays from a ^{60}Co source were applied to egg and larval infestations of the oriental fruit fly, Dacus dorsalis Hendel; melon fly, D. cucurbitae Coquillet; and Mediterranean fruit fly, Ceratitis capitata (Wiedemann), in various fruits and vegetables to investigate such radiation as a quarantine treatment for fresh commodities. A dosage of 10 kR generally prevented immature stages of fruit flies from developing to adults. Dosages over 100 kR failed to prevent pupation. Mortalities were converted to probits, and LD 99.9 and LD 99.9968 determined for the oriental fruit fly and the melon fly. Solo papayas, tomatoes, cucumbers, bananas, litchis, and ripe mangoes tolerated dosages between 25 kR and 100 kR without losing commercial acceptability. Most varieties of avocados and mature-green Haden mangoes were injured by 25 kR. (Auth.)

1648 Bibergal', A.V., Primak-Mirolyubov, V.N. SELECTION OF A RADIATION SOURCE FOR IRRADIATING BULK MATERIALS. Atomn. Energ. 22, 1 (1967) 55-58. (In Russian)-In English translation, p. 64-68.

The effectiveness of irradiation of grains and potatoes to kill insect pests and to prevent germination has been well established. Forced flow is preferable to gravity flow since it minimizes losses due to abnormal irradiation on starting and stopping the plant, and also ensures the greatest constancy and

uniformity of motion within the irradiator. Geometrical considerations play an important role in ensuring a constant absorbed dose throughout the bulk of the material. The cylindrical configuration was more closely examined, determining the efficiency of the system on the basis of the total activity of the central source and the distance of the moving material. Since the relative efficiency of a cylindrical irradiator is relatively low (5-9%), an additional linear source along the axis of the cylindrical irradiator is convenient. The calculations indicated that about 30% of the radiation energy may be absorbed usefully. Only qualitative conclusions could be drawn because "dead angles", reaching areas free from material to be irradiated, were not taken into account. (NSA 21: 1967, 16075)

1649 Boisot, M.H., Gauzit, M. DISINSECTIZATION OF AFRICAN DRIED AND SMOKED FISH BY MEANS OF IRRADIATION. p. 85-94 of "Application of Food Irradiation in Developing Countries. Report of a Panel, Vienna, Austria, 3-6 Aug. 1964". Technical Reports Series No.54. Vienna, International Atomic Energy Agency. 1966, 183p. STI/DOC/10/54.

Fresh water fish are one of the major sources of protein in Africa. More than 100 000 tons of commercial fish are removed from the Niger basin annually and 150 000 tons from the Chad basin. The fish are dried or smoked and shipped throughout Africa. More than 30 wt % of the fish are destroyed by insect infestation (mostly Dermestes and Necrobia) and none of the conventional methods of combating these insects has produced practical results. Results are reported from France on the control of insect infestations in dried or smoked fish by exposure to γ-radiation. Data are included from entomological studies on Dermestes and Necrobia, and on radiation doses necessary to kill these insects during various developmental stages in dried or smoked fish. The exact dose necessary for sterilization has not yet been determined but is estimated as between 15 000 and 40 000 rad. No organoleptic changes were observed at 500 000 rad. The effects of doses of 20 000 to 500 000 rad γ-radiation on the taste of dried and smoked fish of several varieties when exposed in polyethylene bags or removed from them were also studied; the effects of 15 000 to 30 000 rad γ-radiation on the nutritional value of fish; and a study of packaging materials for fish to prevent reinfestation after radiation processing. Studies were also made on the economic feasibility of radiation processing of fish caught in African waters.

1650 Brewbaker, J.L. DOSIMETRY, TOLERANCE, AND SHELF LIFE EXTENSION RELATED TO DISINFESTATION OF FRUITS AND VEGETABLES BY γ-IRRADIATION. p. 58-60 of "6th Annual AEC Food Irradiation Contractors Meeting, Washington, D.C., USA. 3-4 Oct. 1966". CONF-661017, Division of Isotopes Development (AEC), Washington, D.C. 1966, 216p.

Disinfestation and shelf-life extension studies have also included the lychee, ginger, avocado, tangerine, lime, pepper, eggplant, poi, and Japanese fishcake. Insect disinfestation by γ-irradiation appears promising for papaya and mango. Preliminary experiments on possible economic applications in Hawaii are also encouraging for pepper and eggplant. Subtropical fruit flies and the mango seed weevil are the major targets of the University of Hawaii disinfestation programme. A suitable disinfestation (lethal) dose of 33 krad was established for the Oriental fruit fly and melon fly (Dacus dorsalis and D. cucurbitae) although considerably lower doses sterilize these flies. Mango weevils are sterilized by treatments of < 30 krad, and a petition has been made for clearance at that dose.

1651 Carden, J.E. DESIGN OF THE WORLD'S FIRST INDUSTRIAL-SCALE GRAIN-IRRADIATION FACILITY. Isotopes Radiat. Technol. 4 (1967) 398-398.

The design of the world's first industrial-scale (50 t/h) grain irradiator, completed Feb. 1, 1967, is described. (Auth.)

1652 Clor, M.A. COBALT-60 FOR TURKEY FOR A CONTINUOUS GRAIN IRRADIATIVE PLANT. Sci. Cult. 33, 4 (1967) 189.

1653 Comwell, P.B., Ed. "The Entomology of Radiation Disinfestation of Grain". Oxford, Pergamon Press. 1966, 236p.

See III/1010. (For individual papers see also III/641, 651, 811, 869, 870, 899, and 1001.)

1654 Comwell, P.B. CONTROL OF INSECTS IN STORED GRAIN BY IRRADIATION. p. 250-255 of "1st International Food Industries Congress and Exhibition. Proceedings. 8-12 Jun. 1964".

A review of the present state of knowledge and the steps being taken to encourage the application of ionizing radiations for disinfestation of grain is given. The grain is treated in motion, passing through a shield housing the source or machine that delivers the required dose of radiation. Consideration of the physical properties of γ- and electron radiations suggest that grain should be treated during gravity fall. The dose level for grain disinfestation (16 000 rad) does not adversely affect the milling, baking or organoleptic properties of wheat, nor does several times this dose. There is no loss in nutritional adequacy and there is no induced toxicity. The minimum annual throughput of grain which can be treated economically by irradiation is about 200 000 t. The operating costs are competitive with those for conventional measures of insect control. The reliability of ^{60}Co plant and electron machines under conditions of commercial grain handling would require pilot operation for evaluation. (NSA 21: 1967, 24703)

1655 Cornwell, P.B. CONTROL OF INSECTS IN STORED FOOD BY IRRADIATION. Fd Mf, 39, 6 (1964) 38.

Radiation disinfestation by subjecting food to radiation from radioisotopes or from an electron machine are discussed. It is shown that with the grain falling through a system or vertical annuli, 70% of the emissions from ^{60}Co can be utilised. Such irradiation is not harmful to the consumer, and clearance has been given in the USA for the use of radiation energies $\not>$ 2.2 MeV. Advantages of sterilisation by irradiation over fumigation by ordinary methods including immediate reproductive sterilisation, and the delayed death of irradiated insects affords partial protection against reinfestation. Both methods can give 100% control when properly carried out, while irradiation does not affect the milling, baking or organoleptic properties of the wheat. Operating costs of control by irradiation are competitive with conventional methods of insect control.

1656 Cornwell, P.B. IRRADIATION AS A QUARANTINE CONTROL MEASURE. p. 381-393 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation Jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations. Karlsruhe, Federal Republic of Germany, 6-10 Jun. 1966". Vienna, International Atomic Energy Agency. 1966, 956p.

The author considers some suggested irradiation applications using ^{60}Co plant at export/import centres and interstate collecting centres. Irradiation of passenger baggage at airports was planned for pilot evaluation in 1967. The treatment of fruit and vegetables commercially exported from Hawaii is discussed with reference to fruit flies (Dacus cucurbitae, D. dorsalis, and Ceratitis capitata); also, the movement of fruit between states in Australia (C. capitata and D. tryoni). The treatment of timber imports into Australia (wood wasps, Sirex spp. and European house borer, Hyloptrupes bajulus) is discussed for logs, prepared timber, and packing cases. Stored foodstuffs are threatened by the Khapra beetle (Trogoderma granarium), so that irradiation, particularly for shipments, has great possibilities. Examples of possible quarantine operations of eradication, or containment, by sterile-male releases are discussed.

1657 Cornwell, P.B. STATUS OF IRRADIATION CONTROL OF INSECTS IN GRAIN. p.455-471 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation Jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations. Karlsruhe, Federal Republic of Germany, 6-10 Jun. 1966". Vienna, International Atomic Energy Agency. 1966, 956p.

Research into the uses of ionizing radiations for the control of insects infesting stored foodstuffs has demonstrated the technical feasibility of irradiation for the treatment of grain. Studies in radiation entomology have established the susceptibility of the principal grain storage insects and the extent to which environmental factors may modify the efficacy of treatment. Investigations into chemical and physical properties of irradiated grain have shown no adverse effects on organoleptic and manufacturing properties at the dose level required for disinfestation. Work on the wholesomeness of irradiated grain has shown no loss in nutritional adequacy, with the result that clearance has been given in the United States for the human consumption of irradiated wheat and wheat products. Engineering considerations suggest that irradiation is an economic competitor to chemical methods for the treatment of grain at large exporting or collecting centres. With bulk storage and automated conveying systems now established as the most expedient method of handling grain between producers and consumers, it can be wisely predicted that implementation of radiation disinfestation into the

grain-handling industry will follow in the foreseeable future. Information on infestation problems and the grain-handling industries of various countries is used to illustrate the likely future potential of irradiation for the treatment of grain on an international scale. (Auth.)

1658 Dietz, G.R., Lafferty, R.H., Jr. I - USAEC FOOD IRRADIATOR PROGRAM. Fd Irrad. 6, 4 (1966) A35-A49.

The irradiation facilities that are being built in the USAEC food irradiation programme are described. These irradiators, which have capacities ranging from that needed for university research to that required for semicommercial operations, use ^{60}Co or ^{137}Cs as a source of radiation. Essential characteristics such as source strength, production capacity, radiation dose range, and cost are given for the research irradiators, Marine Products Development Irradiator, Grain Products Irradiator, Mobile Gamma Irradiator, Onboard Ship Irradiator, the Hawaii Development Irradiator, and the Portable Irradiator. (Auth.)

1659 Dietz, G.R. STATUS OF AEC IRRADIATOR PROGRAM. p. 85-86 of "6th Annual AEC Food Irradiation Contractors Meeting, Washington, D.C., 3-4 Oct. 1966". CONF-661017, Division of Isotopes Development (AEC), Washington, D.C. 1966, 216p.

Among the irradiators mentioned is the Mobile Gamma Irradiator (MGI), at present located at the Davis Campus of the University of California.

1660 Fazio, C. IONIZING RADIATIONS FOR THE DISINFESTATION OF STORED PRODUCTS. Agricoltore Ital. 12, 4 (1966) 3-6. (In Italian)

1661 Garber, H.J. HAWAII DEVELOPMENT IRRADIATOR (HDI). p. 89-92 of "6th Annual AEC Food Irradiation Contractors Meeting, Washington, D.C., USA, 3-4 Oct. 1966". CONF-661017, Division of Isotopes Development (AEC), Washington, D.C. 1966, 216p.

Details of siting, design, and irradiation capability, housing, and loading are given. The total cost of the irradiation system less source material (^{60}Co) is ~$400 000. Specialized equipment such as source elevator and product conveyor was scheduled for completion by early Feb. 1967.

1662 Golumbic, C., Davis, D.F. RADIATION DISINFESTATION OF GRAIN AND SEEDS. p. 473-488 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation Jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations. Karlsruhe, Federal Republic of Germany, 6-10 Jun. 1966". Vienna, International Atomic Energy Agency. 1966, 956p.

Current interest in radiation treatment of grain and seeds mainly revolves about its efficacy for control of insect infestation in these products. The recent literature on this subject is reviewed and gaps still existing in fundamental and practical knowledge of radiation disinfestation are pointed out. Research programmes in the United States Department of Agriculture that are under way, or planned for the immediate future, are discussed in detail. Current studies are being directed toward establishing min. effective doses for sexual sterilisation and mortality, influence of environmental factors on dose requirements, and potential for the development of biological resistance. In May 1966 the scope of the work expanded as a new grain products irradiator became operative and applied studies were initiated. An integral part of this research is a study of the effect of irradiation on the quality of food and feed grains and on cereal products, at the doses for both insect control and fungal disinfection. This paper examines critically the results of research in this area and estimates future research needs. (Auth.)

1663 Grimblat, G.Y. L'IRRADIATION DES GRAINES EST-ELLE EFFICACE? Kukuruza, SSSR No.11 (1965) 35-36; Is. Ray. Agr. 4, 3 (1966) 3261.

1664 Hayakawa, A., Umeda, K., Shiroishi, M. RADIATION PRESERVATION OF SEVERAL FRESH FRUITS AND VEGETABLES. Shokuryo Kenkyusho Kenkyu Hokoku No.18 (1964) 200-203. (In Japanese)

The use of γ-radiation for increasing the stability of fresh fruits (oranges, persimmons) was studies with a 400-Ci ^{60}Co source. The storage life of these fruits was prolonged when polyethylene bags were used before irradiation. With dosages of 1.28×10^4 to 6.4×10^5 rep, the storage life of

matsutake was increased for at least 7 d. With dosages from $(1.3\text{-}6.4) \times 10^4$ rep chestnuts showed no decrease in organoleptic acceptability, and the possibility of controlling insects in chestnuts by radiation was indicated.

1665 Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center. APPLICATIONS. p. 255-288 of "Research Laboratories Annual Report, January-December 1965". IA-1082. Jun. 1966, 374p.

The use of radioisotopes and Soreq's large ^{60}Co radiation source for application in both industry and agriculture is reviewed. Authorization for using radiation for insect eradication in wheat has been requested.

1666 Kahan, R.S., Eisenberg, E., Lapidot, M. THE ISRAEL FOOD IRRADIATION PROGRAMME AND PROGRESS DURING 1964-1966. p. 743-754 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation Jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations, Karlsruhe, Federal Republic of Germany, 6-10 Jun. 1966". Vienna, International Atomic Energy Agency. 1966, 956p.

The Israel programme on the irradiation of agriculture produce is being co-ordinated by a committee set up by the Israel National Scientific Research Council, consisting of representatives of the Israel Atomic Energy Commission (AEC), The Ministry of Agriculture, and the various growers and marketing associations. The programme is 3-fold: to obtain Government approval of crops already licensed elsewhere (potatoes, onions), to work on local problems (apricots, pears) and on items of export importance (citrus, bananas, avocados). - A 30 000 Ci source was installed in a versatile irradiator of novel design. Objects ranging from a few grams to 50 kg are treated with 20 to 5×10^6 rad doses at dose rates of 1.5-800 krad/h. For citrus, the effects of growing conditions, maturity, irradiation conditions and storage temperature were investigated. 7×10^6 Medflies (Ceratitis capitata) were released per week in a test programme. The lethal doses for immature stages of the fly were determined. A dose of 5.5 krad proved sufficient to prevent emergence of viable adults from any of the stages in laboratory-bred strock and will probably constitute a sufficient dose for quarantine purposes.

1667 Kansu, I.A. AMBAR ZARARLILARI ILE SAVASTA RADYASYONDAN YARARLANMA VE TURKIYEDE YAPILACAK UYGULAMA. (Grain irradiation and the pilot plant to be built in Turkey.) Ankara Üniv. Zir. Fak. Yill. 17 (1967) 172-186. (In Turkish, with English summary)

In 1962, the International Atomic Energy Agency looked into the possibility of setting up a pilot plant. Surveys were undertaken in Pakistan, Turkey and Argentina, and India and Australia were also considered. Turkey appeared to be most suitable for the project, the precise location to be at Iskenderun grain terminal. A ^{60}Co-source giving ~150 000 Ci was planned, the irradiator to be installed as an independent unit, with a handling capacity of 30 t/h, delivering 16 000 rad to the grain (bulk). The dose, too low to kill in a very short time will, however, protect grain against reinfestation by bulk sterilization of the insects. This will be the first commercial project, and will allow a detailed study of the applicability of the method to large-scale operation. Financial support of the project is provided by the UN and the Turkish government. The FAO/IAEA Division of Atomic Energy in Agriculture is responsible for the technical aspects of the operation.

1668 Kumta, U.S., Sreenivasan, A. FOOD IRRADIATION RESEARCH AND PILOT FACILITIES IN OPERATION OR PLANNED IN INDIA. p. 785-803 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation Jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations, Karlsruhe, Federal Republic of Germany, 6-10 Jun. 1966". Vienna, International Atomic Energy Agency, 1966, 956p.

Irradiation facilities, present and planned, are described. The Food Irradiation and Processing Laboratory is to house a ^{60}Co package irradiator (100 000 Ci), a ^{60}Co portable grain irradiator (28 000 Ci) and other facilities for food processing, analytical and research laboratories. The package irradiator is designed for a throughput of 100 lb/h at 0.5 Mrad, and the portable irradiator could handle 500 lb/h of grain at 15 krad. Insect sterilisation and pest control aspects have received considerable attention at the Biology Division of the Trombay Establishment. Since a whole spectrum of insect pests causes damage to stored grains, detailed investigations have been carried out on the effects of γ-radiation on developmental stages (eggs, larvae, and pupae), with special reference to

viability, larval mortality, pupation rate and adult emergence. Considerable differences in the sterilisation dose were noted among the females (6000 rad) and males (16 000 rad) of the Khapra beetle (Trogoderma granarium), a pest on wheat grain. The effective lethal dose for rice weevils of all age groups was found to be 5000 rad. The flour beetle (Tribolium castaneum), the fig moth (Ephestia cautella), and the lesser grain borer (Rhyzopertha dominica) appeared to be relatively resistant, the sterilising dose being near to 10 000 rad. γ-Radiation has advantages over chemical fumigation in being able to sterilise eggs as well as adult insects and in not leaving any toxic residues.

1669 Lurye, L.S., Srapenyants, R.A. USE OF POWERFUL IONIZING RADIATION APPARATUS IN AGRICULTURE. "Vsesoyuznyi Institut Nauchno-Issledovatel'skoi informatsii po sel'skomu khozyaistvu. Moscow, USSR. 1967".

1670 MacFarlane, J.J. CONTROL OF THE QUEENSLAND FRUIT FLY BY GAMMA IRRADIATION. J. econ. Ent. 59, 4 (1966) 884-889.

The lethal effect of γ-radiation on the developmental stages of the Queensland fruit fly, Strumeta tryoni (Froggatt), was investigated. A dose of 80 krad or more was required to kill within 1 d all eggs and larvae treated, but a dose of 5 krad prevented the emergence of adults under normal growing conditions at 25°C. Fractionation of the total radiation dose, or treatment of the larvae at lower temperature, or in a sealed container, was less effective. The radiation resistance of pupae for the first 5 d after pupation was similar to that of mature larvae, LD 50 being near 1.5 krad. Resistance increased rapidly as the pupae aged. The LD 50 exceeded 50 krad for pupae 10 d old. For quarantine purposes a dosage near 5 krad is suggested for the treatment of fruit infested with the Queensland fruit fly. (Auth.)

1671 MacQueen, K.F. POTENTIAL ROLE OF RADIATION IN ALLEVIATING SOME WORLD FOOD PROBLEMS. AECL-2873, Atomic Energy of Canada, Ltd., Ottawa (Ontario). Commercial Products Div. Apr. 1967, 64p. and "International Conference on World Review of Nuclear Reactors and Radioisotopes, Montreal, Canada".

Applications of radiation processing discussed include the control of insect infestation of foods.

1672 Manowitz, B., Kuhl, O.A., Oltmann, A. CONCEPTUAL DESIGNS FOR HAWAIIAN IRRADIATOR AND QUARANTINE DEMONSTRATION IRRADIATORS. BNL-11512, Brookhaven National Lab., Upton, N.Y. 15 Dec. 1963, 51p.

The proposed Hawaiian Irradiator, and two pool-type and one dry unit quarantine demonstration irradiator are described. The Hawaiian Research Irradiator for irradiating fruits and vegetables would contain two 23⅛ in. high by 27½ in. long source plaques each containing 15 000 Ci of ^{60}Co. Auxiliary equipment would consist of a refrigeration unit and a packaged water treatment system. One of the pool-type irradiators has a ^{60}Co plaque positioned vertically in a rectangular well inset into the bottom plate of a cylindrical tank. The cylindrical portion of the tank is 12½ ft deep filled with water. The unit is underground and is designed for two-pass operation. The source is made up of 75 individual, double-encapsulated Brookhaven ^{60}Co strips. Two ^{60}Co source loadings are considered, one of 85 000 Ci and one of 425 000 Ci. The 2nd pool irradiator uses an inclined tunnel rather than a vertical elevator, lead shielding is provided on the underside of the pool, multiple passes are employed to take advantage of "shine through", and "spent" source material is used with regular source material. Mechanical handling of food packages in the dry unit are the same as those used in the pool-type irradiator. The dry unit is also located underground. A shipping cask provides shielding above the source. The irradiator uses 50 Brookhaven source strips. (NSA 21: 1967, 34404)

1673 Manowitz, B. STATUS OF GAMMA IRRADIATOR DESIGN. BNL-10257, Brookhaven National Lab., Upton, N.Y. Apr. 1966, 39p.

The status of γ-irradiator design for the destruction of bacteria and insects and for the initiation of chemical reactions is reported. (NSA 20: 1966, 35806)

1674 Marais, P.G., Potgieter, L., Hawkins, C.S., Hanekom, J. ^{60}Co IRRADIATION UNIT FOR AGRICULTURAL RESEARCH. S. Afr. J. agric. Sci. 7 (1964) 837-862.

A ^{60}Co irradiation unit is described and illustrated in detail that was designed for the irradiation of a wide range of materials. The ^{60}Co source consists of two 2 × 17 mm discs with a total activity of 488 Ci. The manipulation of the source is entirely mechanical and is controlled from the outside. A labyrinth-type construction attenuates the dose near the chamber. Various sample holders were constructed for the irradiation of fruit, vegetables, soil, microorganisms, plant materials and insects. With the source raised above floor level, dose-rate measurements were carried out in vertical directions at different distances from the source. An important feature of the source arrangement is that samples can be placed close to the source by means of a turntable, so that irradiation of small samples at a dose rate of 500 000 rad/h is possible. (NSA 20: 1966, 697)

1675 Mariani, A. TECHNIQUES OF THE FUTURE FOR THE PRESERVATION OF FOOD PRODUCTS IN DEPOSITS. Atti Corso Qualificazione Tec. Ent. Merceologica, 1963 (1964) 85-93. (In Italian)

Radiopreservation of food is reviewed with emphasis on required doses, units of measurement, radiation intensity, and the interaction of radiation with matter. Direct and indirect effects of radiation on biological and chemical systems are discussed. Radiosensitivity of the various stages in the life cycle of common pests are reviewed. Grain product irradiation is considered economically with particular reference to the situation in Italy. (NSA 20: 1966, 25453)

1676 Matsuyama, A. RECENT ADVANCES IN FOOD IRRADIATION RESEARCH IN JAPAN. p. 767-784 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation Jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations. Karlsruhe, Federal Republic of Germany, 6-19 Jun. 1966". Vienna, International Atomic Energy Agency. 1966, 956p.

Practical studies on food irradiation fall into three categories, depending on their purpose: (1) radiation preservation, (2) the elimination of harmful biological and biochemical factors in foods, from the point of view of public health, and (3) the utilization of the chemical effects of radiation. At present, there are about 30 kCi-scale sources of radioisotopes, and almost the same number of electron generators, including some pilot-scale irradiation facilities, such as a 240 000-Ci ^{60}Co-source in Japan. A realistic dose for grain disinfestation in Japan would be in the range of 10-50 krad, judging by results obtained to date, although definite conclusions as to the appropriate disinfestation dose must await further investigations as part of the new national programme. Irradiation of the soybean and azuki bean have also been studied, to control insect and microbial spoilage; somewhat higher doses, 0.1 Mrad for soybean and 0.1-1 Mrad for the azuki bean, have been recommended.

1677 Mayer, E.L., Tilton, W., Laudani, H. p. 69-70 of "6th Annual AEC Food Irradiation Contractors Meeting, Washington, D.C., 3-4 Oct. 1966". CONF-661017, Division of Isotopes Development (AEC), Washington, D.C. 1966, 216p.

A mobile unit (Atomic Energy of Canada Ltd.) was used for determining effects of γ-irradiation on six beetles, two moths, and the grain mite.* Resistance of beetles and moths to radiation increased with advance in life stages. With the mite, however, the most resistant stages were the adult, egg, and hypopus, with the larva showing least resistance. - The bulk-grain and packaged-commodity irradiator in Savannah awaits calibration and subsequent operation (at the time of writing). Radiation exposure to 20-25 krad upset the development of grain-infesting species. Chemical bioassay analyses of grain treated at 25 and 100 krad indicate no noticeable degradation of malathion residue during a storage period of six months. - A research programme is outlined.

* No details given.

1678 Mouton, R. APPLICATIONS OF INTENSE RADIATION SOURCES TO BIOSYNTHETIC FOOD AND MEDICAMENTS. PART III. Inds atom. 8, 11 (1964) 78-85. (In French)

The use of intense radiation sources for the radiation processing of foods, pharmaceuticals, and medical supplies is discussed. Examples cited include the preparation of antihelminthic and bacterial vaccines, the radiosterilization of thermolabile pharmaceuticals, the treatment of grain for the destruction of insect pests, and the radiation processing of potatoes and onions to increase the storage life. The economic potentialities of radiation processing and the possibility of combining radiation with other chemical and physical treatments are discussed. (NSA 19: 1965, 13829)

1679 O'Loughlin, G.T. CONTROL OF QUEENSLAND FRUIT FLY. J. Agric. Vict. Dep. Agric. 62, 9 (1964) 391-401.

The discovery of the Queensland fruit fly in Victoria in 1946 and its spread during the century from Queensland through New South Wales is traced. It is now established in Eastern Victoria. The life history of the fly is described. The occurrence of geographic races has been demonstrated by studying the survival of flies at cool temperatures. Various control measures are considered. An investigation of the possible application of sterile male releases is being carried out by the C.S.I.R.O. but is likely to prove difficult as flies can survive for several months and are known to mate more than once. It is also expected that costs would prohibit the use of the method on a large scale. Mention is made of the potential use of γ-irradiation for infested fruit.

1680 Okanoue, S., Fukutani, M., Sugihara, M., Hashida, I. STUDIES ON THE PRESERVATION OF FOODS AND THE CHANGES OF THEIR NUTRIENT COMPONENTS BY GAMMA-RAY IRRADIATION. IV. EFFECTS ON THE RED BEAN. Radio-Isotopes, Tokyo 14 (1965) 93-95. (In Japanese)

Studies were made on the prevention of mould growth and vermin damage on red beans by γ-irradiation. The optimum dose was determined. Red beans were irradiated by ^{60}Co γ-rays at a dose of from 0.05×10^4 to 100.0×10^4 R in about 1/7 mm thick polyethylene film bags. Atmosphere was air or nitrogen. After irradiation, samples were stored at room temperature for 30 months. Outward appearances, tastes, and contents of fats were estimated. Immediately after irradiation, outward appearances remained unchanged. Irradiation at a dose of 1.0×10^4 R could not keep red beans from getting mouldy, but irradiation at 10.0×10^4 to 100.0×10^4 R was effective in suppressing the mould growth. A higher dose was even more effective. The boiled states and the tastes of the samples were equally good as compared to the control in every case. The contents and the characteristic properties of the fats were almost unchanged by γ-irradiation. Vermin were not found during storage. Therefore it was desirable to irradiate red beans that contained fats in small quantities and carbohydrates in large quantities at a dose of 10×10^4 to 100×10^4 R in air. Good results were not obtained by irradiation of the red beans in N atmosphere as in the case of soybeans. (NSA 19: 1965, 24893)

1681 Okanoue, S., Fukutani, M., Sugihara, M., Hashida, I. STUDIES ON THE PRESERVATION OF FOODS AND THE CHANGES OF THEIR NUTRIENT COMPONENTS BY GAMMA-RAY IRRADIATION. V. EFFECTS ON THE RICE. Radio-Isotopes, Tokyo 14 (1965) 97-102. (In Japanese)

The prevention of mould growth and vermin damage on rice by γ-irradiation was studied. Rice was irradiated by ^{60}Co γ-rays at a dose of 0.5×10^4 to 400.0×10^4 R in about 1/7 mm thick polyethylene film bags in an atmosphere of air or N. After irradiation, samples were stored at room temperature for 18 months. Outward appearances, tastes, and changes in nutrient components were estimated. Relations between irradiation doses and these factors were investigated and the optimum dose was determined. Irradiation at a dose of more than 40.0×10^4 R caused the colouration of yellowish brown and its density increased with irradiation dose. Vermin did not grow when irradiated at a dose of more than 4.0×10^4 R. Irradiation at 40.0×10^4 R could keep the rice from getting mouldy and prevent the vermin damage. In N atmosphere results were better in some degree. When irradiated at less than 4.0×10^4 R, taste of the boiled rice was good, but over 40.0×10^4 R, the boiled rice was not fit for eating and after six months' storage this difference became quite remarkable. Effects of irradiation on the contents of water and fats were not recognized. Acid value was most changeable by irradiation and more increased in the polished rice than in the unpolished one. The specific gravity, refractive index, saponification value, and I-number were almost unchanged until six months later, but after 18 months' storage, the acid value increased and both the refractive index and the I-number decreased with the irradiation dose. These changes were also more remarkable in the polished rice than in the unpolished one. It was concluded that for the preservation of rice, it is preferable to irradiate at a dose of 10.0×10^4 R on unhulled rice and polish it before cooking. (NSA 19: 1965, 24894)

1682 Otagaki, K.K. HAWAII DEVELOPMENT IRRADIATOR - A NEW TOOL IN TROPICAL FRUIT PROCESSING. Paper presented at the "8th Japan Conference on Radioisotopes, Tokyo, Japan, Nov. 13-16, 1967". AED-Conf. 1967, 381-011.

The prospects for commercial utilization of irradiation to achieve shelf-life extension and effective disinfestation of tropical fruits are very encouraging. Doses of > 21 krad prevent the development

of adult fruit flies in infested fruits and retard ripening and senescence, thus improving shelf-life of papayas, mangoes, and other tropical fruits. Mango seed weevils, not affected by the commercial level of fumigation for papayas, are controlled by > 25 krad. A ^{60}Co-source of 220 000 Ci is available, with a throughput of 4000 lb of packaged papayas/h; it is, however, designed for a 500 000 Ci capacity with a max. throughput of 12 000 lb/h. The system can treat semi-commercial quantities at doses from 15 to > 500 krad, doses suitable for pasteurization or disinfestation. Details of the installation, economics, and projects are given.

1683 Powers, J.J. IRRADIATION OF GRAIN AND POTATOES. p. 39-48 of "Conference on Radiation Preservation of Food. Oak Ridge, Tenn. 2-3 Feb. 1967". CONF-670202, Southern Interstate Nuclear Board, Atlanta, Ga. Jun. 1967, 100p.

Some mention is made of work in process on disinfestation of grain, both in terms of irradiation of bulk grain and of packaged grain products.

1684 Proost, M. L'EFFORT BELGE EN MATIERE D'IRRADIATION DES ALIMENTS. Mede. LandbHoogesch. OpzoeklStns Gent 30, 2 (1965) 667-672.

Les diverses applications ont été classées en trois catégories selon les doses appliquées pour obtenir l'effet désiré: (1) traitements à faibles doses (50 000 rads ou moins); (2) traitements à doses moyennes (50 000 rads à 1 Mrad); (3) traitements à hautes doses (2 à 5 Mrads). Parmi les traitements à faibles doses figure la stérilisation des insectes infestant les produits alimentaires. Une dose de 5 à 10 000 rads est suffisante pour désinfester les denrées alimentaires entreposées. Dans ce cadre, la Station d'Entomologie de l'Etat à Gembloux a effectué une série d'expériences sur des calandres. La résistance de divers stages de développement de Sitophilus granarius L. et S. oryzae L. aux irradiations a été vérifiée. En collaboration avec le C.E.N., une étude sur la radiorésistance des Acanthoscelides obtectus, un coléoptère infestant les haricots blancs, est en cours. Des expériences analogues sont effectuées au "Leerstoel voor Dierkunde, Rijkslandbouwhogeschool à Gand sur la teigne de la farine, Ephestia kuehniella Z.

1685 Reiback, E., Morton, M.R. BULK-GRAIN-IRRADIATOR DESIGN. Trans Am. nucl. Soc. 8 (1965) 323-324.

A prototype irradiator designed by Vitro Engineering Co. to handle 5000 lb/h of grain at 25 000 rad is under construction at the USDA Experiment Station, Savannah, Ga. The grain flows in a square bin, through a source array consisting of doubly encapsulated strips of ^{60}Co, arranged in parallel rows in a horizontal plane. The grain is kept a min. distance from any ^{60}Co-source by an aluminium sheath around each source. The basic advantage achieved by this configuration is that the product approaches the source very closely. The product surrounds the source except at its perimeter, extending to 3 ft in depth above and below the source plane. Thus the loss of unabsorbed photons is minimized. These factors contribute to the unusually high efficiency for this irradiator, which is expected to exceed 50%. The nuclear analysis of the product dosimetry was made using a modified version of an IBM-7094 programme called Fudge-3A. Flow tests were made using transparent-sided bins to determine the flow profile of a variety of grains past the grid of source rods. Appropriate bin bottoms and vibration modes were developed to achieve a uniform product flow. The prototype irradiator has an additional package capability. - A schematic illustration of the design is given.

1686 Rukavishnikov, B.I. GAMMA IRRADIATION OF GRAIN AND OTHER RESERVES FOR STERILIZING AND EXTERMINATING PESTS. Sel'.-khoz. Rubezhom Rastenievodstvo 2 (1964) 58-63. (In Russian)

The author lists lethal and sterilising doses of γ-rays for various insects and mites which damage grain, fruit, furniture, etc. Resistance to lethal and sterilising actions of γ-rays increases, depending upon the extent to which insects have developed from egg to imago and, within one stage of development, with an increase in age. Instead of receiving a single dose, grain was irradiated with divided doses of γ-rays (one or more exposures to sublethal or sterilising doses which, taken together, equalled or slightly exceeded the lethal or sterilising dose for a single exposure) which made it possible to reduce the cost of treatment by a considerable reduction in the output of the source of radiation and had the advantage that insects were sterilised but not killed. With divided doses of irradiation germ-cells were irreversibly damaged, but damaged tissues in the body were able to regenerate in the interval between exposures. The author describes laboratory and industrial (portable and

stationary) equipment used for γ-irradiation. He compares the effectiveness of γ-irradiation and fumigation for grain and other agricultural products. (BA)

1687 Rukavnishnikov, B.I. GAMMA IRRADIATION OF GRAIN AND OTHER RESERVES FOR STERILIZING AND EXTERMINATING PESTS (REVIEW). Translation Referat. Zh., Biol. (1964) 58-63. 22E194. (See 1686)

With fractionated doses, germ cells were damaged irreversibly but body tissues were able to regenerate; insects were sterilised but not killed.

1688 Rushford, F.E. PUERTO RICO NUCLEAR CENTER. ITS PRINCIPAL IRRADIATION FACILITIES AND SCIENTIFIC PROGRAM. Isotopes Radiat. Technol. 4, 3 (1967) 251-255.

The chief irradiation facility at the PRNC is an AMF pool-type research reactor; a 10 000 Ci ^{137}Cs source is also available. Apart from food irradiation programmes, the possible applicability of the sterile male technique, using γ-irradiation, to the sugarcane borer, Diatraea saccharalis (Fab.) is under investigation. Various other programmes are discussed.

1689 Ruwe, D.M., Murphy, G., Bockhop, C.W. GAMMA-RAY ATTENUATION COEFFICIENTS OF GRAINS AND FORAGES. Am. Soc. agric. Eng. Trans. 9, 3 (1966) 312-313.

Some γ-ray irradiation facilities have been built and others are planned for the eradication of insects from grain as it is transported to and from storage. The in-storage irradiation of grain for mould and insect control has not been utilised, largely because of the lack of knowledge regarding the interaction of γ-rays with grain. Linear and mass attenuation coefficients can, however, be measured accurately and the measured values are in good agreement with theory. The density of the material and the number of electrons per atomic mass unit (0.536) are the important parameters in determining the attenuation coefficients. The kind of grain or forage and the moisture contents of these materials have negligible effects on the attenuation coefficients.

1690 Scott, W.J. FOOD IRRADIATION IN AUSTRALIA. Fd Irrad. 2, 4 (1962) A4-A5.

All food irradiation research in Australia is carried out at the A.A.E.C. Research Establishment at Lucas Heights. Radiation sources are an underwater ^{60}Co irradiator which soon will have a strength of 10 000 Ci, a fuel element of 100 Mrad/cc/d, and a small Van de Graaff accelerator. At Dandenong near Melbourne, a very large ^{60}Co source (500 000 Ci), operated commercially for disinfecting animal hair, will also be available for food irradiation. Presently, food preservation is investigated at a low dosage of 10^4 rad at which level no organoleptic changes are detectable. Interest is concentrated on the preservation of fruits which are often infested with the Queensland fruit fly Strumeta tryoni. Dosages of 10 000 rad, which are necessary to kill the insect, have not produced noticeable organoleptic changes in citrus fruits. Dosages of 5000 rad control the sprouting of potatoes under Australian conditions for 6 months. However, the introduction of the commercial irradiation of food must await acceptance by the Public Health Authority which carries out experiments with irradiated foods on animals. (Auth.)

1691 Talhouk, A.S. PROSPECTS AND NEEDS FOR RADIATION DISINFESTATION OF PACKED FRUITS AND VEGETABLES. p. 105-113 of "Applicaton of Food Irradiation in Developing Countries". Technical Reports Series No.54. Vienna, International Atomic Energy Agency. 1966, 183p. STI/DOC/10/54.

In countries with adequate precipitation or irrigation water and high average yearly temperatures the growth of particular crops is favoured. The suitable climatic conditions, however, favour the multiplication of many pests in the stores. The problem of pests of packed fruits and vegetables, although cosmopolitan, presents a particular concern to the developing countries. The pests that are likely to be affected by irradiation and are less susceptible to the conventional methods of control are discussed, and recommendations made. Some specific instances are given where radiation disinfestation would be very useful. Amongst the serious pests of packed fruits and nuts are the dried fruit moths, Ephestia cautella, E. elutella and the polyphagous Pyralis farinalis and Plodia interpunctella. Owing to the lack of forced diapause during their life cycle, these pests reproduce uninterruptedly in the warehouses and ship hulls, and often render the expensive goods utterly unsalable by the time the cargo reaches the retailer, or even the wholesaler. The

commodities often contain Tribolium confusum, T. castaneum as well as a number of Cucujid beetles of cosmopolitan distribution. These beetles, as well as the Calandra granaria and oryzae, spend their entire life in or on the commodities, which fact makes irradiation more advantageous than the conventional methods of treatment. Other serious pests are Ceratitis capitata, the red spider, Metatetranychus ulmi and Tetranychus urticae, and the potato tuber moth Phthorimea operculella.

1692 Tape, N.W., Ferguson, W.E. QUALITY EVALUATION OF IRRADIATED PAKISTANI RICE. Fd. Irrad. 7, 1/2 (1966) A22-A25.

Data are given on the effects of γ-radiation on control of insects on rice. The rice was packaged in 4-lb lots in polyethylene bags. Several 4-lb samples were irradiated by the Atomic Energy of Canada Ltd. in a Gammacell 220 (^{60}Co γ-radiation at a rate of approx. 1.3 million rad). Samples were exposed to 15 000 rad, 30 000, and 60 000 rad. This range was selected because of the approved dose range for wheat in the United States and the results of Watters. The latter found that no progeny of six common grain infesting insects were obtained from adults irradiated in wheat at 12 500 rad or higher. Sensory and objective tests were conducted in the Food Research Institute to determine if differences in quality existed between the control and irradiated rice. Vitamin assays were made in the Food and Drug Directorate (Department of National Health and Welfare). The irradiation of rice to control insect infestation does not have any effect on rice quality. The flavour, texture, and colour of rice was not affected by 30 000 rad. Some indication of a harmful effect on flavour was observed in rice irradiated with 60 000 rad. However, this dose level is more than that required for insect control. The niacin and thiamine content was not changed by irradiation. (Auth.)

1693 Török, G., Farkas, J., Vas, K. RÖNTGENSUGÁRZÁS HATÁSA RAKTÁRI RAVARKÁRTEVŐKRE. (x-Ray irradiation effects on storehouse destructive insects.) Konzerv-Hus Hűtőipari Kut. Intézet. Közl., Budapest 1 (1959) 23-30. (In Hungarian, with English summary)

The radiation tolerance of the salami pest, Enicmus minutus L., and of some flour pests was studied. Irradiation was carried out with apparatus of a 46.7 krad/h capacity, using dose levels of 3, 6, 12.5, 25, 50, 100, and 200 krad/h, at 200 kV. Even with the highest dose there was no immediate destruction of insects. The effect of radiation manifested itself in a gradual lowering of the average life span. Percentage mortality greatly depends on the period of observation. By means of probit analysis it was possible to determine the doses required to give 50% mortality on the 6th, 12th, and 15th day after irradiation. The doses required to accelerate mortality do not go up proportionately: to achieve 50% mortality in 6 instead of 12 days, the original dose needs to be increased 8 to 10-fold. With E. minutus, radiation tolerance varies with age: young adults are much less resistant than older ones. Radiation sensitivity was greater than in the flour pests tested. Metamorphosis in larvae was stopped by 50-h irradiation. Mortality graphs were similar to those obtained for adults.

1694 Deleted.

1695 Török, S., Farkas, J. RESULTS, DEVELOPMENT AND PROSPECTS OF RESEARCH MADE IN THE APPLICATION POSSIBILITIES OF IRRADIATION IN FOOD-INDUSTRIES. Orsz. Műszaki Fejl. Biz. Budapest 1962.

1696 Upadhya, M.D., Brewbaker, J.L. IRRADIATION OF MANGOES FOR CONTROL OF THE MANGO SEED WEEVIL (Sternochetus mangiferae). Hawaii Fm Sci. 15, 1 (1966) 6-7.

S. mangiferae (Fabricius) is restricted to the hard-shelled seed so that standard fumigation methods are almost wholly ineffective against it. Irradiation of infested fruit in the Hawaii Research Irradiator led to no survival in adults after 120 krad and three weeks of storage, while 60 krad sufficed for complete lethality after five weeks of storage. Most "live" weevils remaining after 30 krad or more succumb sooner or later to their irradiation injuries. Adults are most resistant to irradiation. Preliminary data indicate that sterilization occurs after > 10 krad. Further experiments showed that mango varieties like Haden and Pirie tolerate doses that successfully control the weevil, without altering their appearance or flavour. Shelf-life extension of fruits was an unexpected bonus of radiation treatment in the disinfestation range.

1697 Upadhya, M.D., Brewbaker, J.L. EFFECTS OF GAMMA IRRADIATION ON THE PINEAPPLE. Hawaii Fm Sci. 15, 1 (1966) 8-9.

Fruit flies attack all fresh pineapples but the larvae are generally restricted to the shell and often fail to pupate. Preliminary studies indicate that disinfestation in the dose range of 30-50 krad also brings about a significant extension of shelf life without producing undesirable changes in fruit appearance or quality. (The crowns of irradiated fruits could not be used to establish growing plants since irradiation above 15 krad inhibits rooting.)

1698 Val Cob, M. del., Ortin Sune, N. FOOD PRESERVATION BY IRRADIATION. I. EVOLUTION AND PRESENT STATUS IN THE WORLD. AEC-TR-6690, Junta de Energia Nuclear, Madrid (Spain). 1965, 61p. Translation of Report: JEN-158-S1/1-15.

Review article, with a relatively brief section on de-insectation of cereals and stored products.

1699 Watters, F.L. EFFECTS OF GAMMA IRRADIATION ON THE LONGEVITY AND FERTILITY OF FIVE SPECIES OF STORED-PRODUCT INSECTS. Bull. ent. Soc. Am. 12 (1966) 265. Abstr. 338. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov.- 1 Dec. 1966".

A mobile ^{60}Co-source was used to irradiate insects in wheat at dosages of 6250 - 150 000 rad. Results are presented on: (1) initial and delayed mortalities; (2) fertility of survivors; (3) germination, and milling and baking tests of wheats irradiated at 13 and 16% moisture content. (Abstr.)

1700 Wootten, C.B. OPERATION OF THE PORTABLE CESIUM IRRADIATOR. p. 96 of "6th Annual AEC Food Irradiation Contractors Meeting, Washington, D.C., USA. 3-4 Oct. 1966". CONF-661017, Division of Isotopes Development (AEC), Washington, D.C. 1966, 216p.

(First operation of the unit for demonstration purposes was scheduled for March 1967.)

See also:

1342 Gross effects of gamma radiation on the Indian-meal moth and the Angoumois grain moth. (Cogburn, R.R. et al., 1966)
1344 Belgium contributions to the data on irradiation of substances. (DeProost, M., 1965)
1359 Radiation susceptibility of various developmental stages of the Mediterranean fruit fly (Ceratitis capitata Wied.). (Kahan, R.S. et al., 1965)
1436 Study of the irradiation tolerance of some destructive storehouse insects and technical and economic aspects of insect destruction by irradiation. (Farkas, J., 1965)
1625 The defense department is on its third test procurements of irradiated food... (Anonymous, 1967)
1627 Insect infection of African dried or smoked fish and the possibility of its control by irradiation. (Daget, J., 1966)
1628 Advances in storage technology with special reference to the tropics. (Dobrovsky, T.M., 1965)
1630 Possible applications to food of ionizing and nonionizing radiations. (Goldblith, S.A., 1967)
1631 Latest approaches to flour mill pest control. (Goosens, H.J., 1964)
1701 Economics of grain irradiation. (Baines, B.D. et al., 1966)
1702 Economic aspects of the food irradiation programme in Israel. (Lapidot, M. et al., 1966)
1780 Information circular on Radiation Techniques and their Application to Insect Pests. No.7. (International Atomic Energy Agency, Vienna (Austria). 1966)

2.4.3.3. Economics

1701 Baines, B.D., Mosely, J. ECONOMICS OF GRAIN IRRADIATION. p. 813-831 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation Jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations. Karlsruhe, Federal Republic of Germany, 6-10 Jun. 1966". Vienna, International Atomic Energy Agency. 1966, 956p.

After three years in which preliminary designs were prepared, a grain irradiation plant has been designed and is being built into an existing silo installation. From this experience actual costs of plant construction are available for a plant using ^{60}Co, and this experience is incorporated in estimates for machine installations for high grain throughput. Costs are compared for plants of compa-

rable complexity, and they indicate those areas in which each type of plant is pre-eminently suitable and those areas where either type may be best, dependent upon local site conditions, the standard of local technology and methods of operation. The two plants compared are described in sufficient detail to enable the precise extent of the equipment supply covered by the costs to be appreciated. The accounting methods employed have been discussed with industrial accountants to ensure that they are acceptable to the potential users. The methods employed are explained so that they can be applied to problems of a similar nature. (Auth.)

1702 Lapidot, M., Foa, E., Sivan, Y., Kahan, R.S. ECONOMIC ASPECTS OF THE FOOD IRRADIATION PROGRAMME IN ISRAEL. p. 851-864 of "Food Irradiation. Proceedings of the International Symposium on Food Irradiation jointly Organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations. Karlsruhe, Federal Republic of Germany, 6-10 Jun. 1966". Vienna, International Atomic Energy Agency. 1966, 956p.

The economics of food irradiation must be surveyed on a national scale at the outset of any ambitious technological feasibility study programme. This must be followed by detailed economic studies as the programme progresses. Such a technological-economic survey of radiation-preserved agricultural produce was made in Israel in July 1965. All items which, potentially, could benefit from irradiation (fruits and vegetables, fodder, cereals and cereal products, fish, meat, poultry and poultry produce) were examined. Irradiation costs were estimated on the basis of available and extrapolated data for small irradiators in the growth areas and for large irradiators in ports or along main highways. Surface treatment by electron accelerators and bulk treatment by ^{60}Co, ^{137}Cs or x-ray sources were considered. The survey was useful in formulating the programme for detailed technological applications for the period up to 1971. - Disinfestation problems could easily be solved by incorporating irradiation sources in the flow patterns of the fodder through the silo. This would be at a minimum cost because of the simple design of the irradiation facility and the very efficient radiation absorption. Preliminary packing and service irradiation in central facilities would allow disinfestation of cereal products at an irradiation cost of < 1% of their value. Irradiation at low doses would provide satisfactory quarantine measures for citrus fruit, and would also allow bulk sale in large shipping containers, or pre-packaging in small perforated plastic bags. - The sterile male technique used on Ceratitis capitata shows great promise here.

See also:

1436 Study of the irradiation tolerance of some destructive storehouse insects and technical and economic aspects of insect destruction by irradiation. (Farkas, J., 1965)
1547 Towards better insect control. (Nelson, S.O., 1965)
1634 Preservation of food by low-dose ionizing energy. (Quartermaster Research and Engineering Center, Natick, Mass., 1961)
1639 Two cobalt irradiators for a food-treatment lab at India's Trombay atomic energy establishment.... (Anonymous, 1966)
1640 Grain irradiation plant. (Anonymous, 1967)
1642 A 150,000 curie cesium irradiator will begin touring the country.... (Anonymous, 1966)
1643 100,000 curies of cobalt for the large grain irradiator in Turkey.... (Anonymous, 1966)
1645 The world's first large-scale continuous grain irradiation plant, Iskenderun, Turkey. (Anonymous, 1967)
1654 Control of insects in stored grain by irradiation. (Cornwell, P.B., 1964)
1658 I - USAEC food irradiator program. (Dietz, G.R. et al., 1966)
1661 Hawaii development irradiator (HDI). (Garber, H.J., 1966)
1668 Food irradiation research and pilot facilities in operation or planned in India. (Kumta, U.S. et al., 1966)
1675 Techniques of the future for the preservation of food products in deposits. (Mariani, A., 1964)
1682 Hawaii development irradiator - a new tool in tropical fruit processing. (Otagaki, K.K., 1967)
1685 Bulk-grain-irradiator design. (Reiback, E. et al., 1965)

2.4.3.4. Detection and Damage Assessment

1703 Calderon, M., Binyamini, N. DAMAGE TO BISCUITS CAUSED BY Lasioderma serricorne (F.) (AND DATA ON ITS BIOLOGY AS SHOWN BY RADIOGRAPHS). Teva Vearetz 2, 6 (1960) 1-6. (In Hebrew, with English summary)

A heavy infestation of stored biscuits by L. serricorne is recorded and the type of damage described. The detection of hidden infestation by means of radiographs is illustrated. Preliminary work on the biology of the insect in biscuits is described, aimed at demonstrating the use of x-rays in the study of the life cycle of insects, in particular borers in stored products. As a result, the following data were obtained, at 30 °C and R.H. 83%: (1) the size of larvae ranged from 0.82 mm-2.8 mm (full size). Pupae are 2.4 ± 0.34 (standard deviation) mm long; (2) one generation (from adult to adult) takes 38.9 ± 1.00 (SD) d, the pupal stage lasting for 6.8 ± 1.22 (SD) d. - Further work is being carried out to obtain additional data. (Based on auth.)

1704 Freeman, C.C. CRITERIA FOR RADIOGRAPHIC EXAMINATION OF INTERNAL INSECT INFESTATION. J. Ass. off. agric. Chem. 48, 6 (1965) 1183-1185.

The insect tunnel is considered the common denominator for radiographic examination of internal insect infestation. General characteristics of insect tunneling are described to distinguish between natural appearance and infestation. Certain criteria have proved applicable to insect tunneling in green coffee beans and other products: rounded terminal ends, parallel walls (primarily true for tunneling in coffee beans), the presence of insect excreta (small patches of granular material visible through a magnifier) and insects (often only visible as ghostly shadows due to lack of moisture), uniform size, definite margins (even when contrast is poor), and tunnels devoid of plant tissue. Coffee beans have certain characteristics which cause confusion to the analyst, such as infoldings and convolutions and, in particular, the germ, especially in old coffee beans that have lost moisture during storage. However, with practice a rapid radiographic analysis is feasible.

1705 Mills, R.B. LABORATORY STUDIES OF THE BIOLOGY AND BEHAVIOR OF THE ANGOUMOIS GRAIN MOTH, Sitotroga cerealella (Oliv.) Diss. Abstr. 25 (1965) 1424-1425.

In part of the study radiography was used. Daily x-ray radiographs were made of the larval-pupal development of 73 insects in wheat kernels, 44 in corn, and 66 in sorghum, using a G. E. Grain Inspection x-Ray Unit. Study of the series of enlarged photographic prints made from these radiographs revealed shorter larval-pupal periods if larvae fed on germ soon after entering the kernels. Penultimate and last larval instars, prepupae, and pupae could be distinguished in radiographs. Insects with longer larval-pupal periods spent more of this additional time in the earlier stadia than in the penultimate and last larval stadia, and pupal period. These later stages were remarkably uniform in comparison to the earlier ones. The late-developers were in the endosperm without access to germ during the early stadia.

1706 Mills, R.B., Wilbur, D.A. RADIOGRAPHIC STUDIES OF ANGOUMOIS GRAIN MOTH DEVELOPMENT IN WHEAT, CORN, AND SORGHUM KERNELS. J. econ. Ent. 60, 3 (1967) 671-677.

Daily x-ray radiographs were made of 73 wheat, 44 corn, and 66 sorghum kernels to study (with little or no disturbance to the insects) development and behaviour of larvae and pupae of Angoumois grain moth, Sitotroga cerealella (Olivier), inside the kernels. Lengths of later stadia were generally ascertained, because time of moulting to the penultimate and last instars usually could be determined. The ranges and means of the periods from hatching to penultimate instar were 8-33 d and 14.9 d in wheat, 9-28 and 13.9 d in corn, and 7-31 and 12.9 d in sorghum; the penultimate larval period was 4-10 and 5.3 d in wheat, 3-7 and 4.7 in corn, and 3-7 and 4.5 in sorghum; ultimate larval period (including prepupa) 6-12 and 8.3 d in wheat, 6-10 and 7.9 in corn, and 5-8 and 6.4 in sorghum; pupal period 8-11 and 9.6 d in wheat, 7-10 and 8.9 in corn, and 7-10 and 9.3 in sorghum. Ranges and means of the total larval-pupal periods were 29-63 and 37.9 d in wheat, 28-52 and 35.3 in corn, and 25-54 and 33.0 in sorghum. Insects with longer developmental periods spent disproportionately more time as earlier instars than the insects with shorter developmental periods. (Auth.)

1707 Perutik, R. AN x-RAY DEVICE FOR THE DEFECTOSCOPY OF SEEDS. TO DETERMINE HEALTHY, INFESTED AND BARREN SEEDS OF OATS AND WINTER BARLEY. Ochr. Rost. Min. Zem. Les. Hosp., UVTI, Sb. 39, 1 (1966) 37-42. (In Czech)

2.4.4. Sericulture

1708 Beard, R.L., Saovanee Chakpitak. KILLING SILKWORM PUPAE BY IRRADIATION. p. 12-13 of "Insect Eradication by Irradiation, Bangkok, Thailand, 28-29 Jun. 1966". THAI.AEC-8, Office of Atomic Energy for Peace, Bangkok (Thailand).

Reports from the USSR suggested that γ-irradiation of cocoons might be superior to heat treatment. The advantages claimed included improved reeling and dynamometric properties, increased yield, less alteration in sericin characteristics, and improved preservation of cocoons for storage. Improved knitting properties because of increased lyophilic and adhesive properties were also observed. - Two lots of 50 fresh silkworm cocoons were each given a dose of 100 000 rad or heat treatment of 52-54°C for 3 h, respectively. The irradiated pupae continued to show some activity for 8-10 d, were of a lighter colour, and had retained their original shape and consistency; their weight was 5.4 g as compared to 2.8 g for heat-treated cocoons. These preliminary tests suggest that the principal difference between the two methods lies in the weight retention and better reeling properties of the irradiated cocoons.

1709 Hossain, M.M., Mallik, M.U., Mollah, S.A. SERICULTURE IN EAST PAKISTAN AND ROLE OF ATOMIC ENERGY FOR ITS IMPROVEMENTS. AECD-RB-3, Atomic Energy Centre, Dacca (Pakistan), Jul. 1966, 17p.

The use of atomic energy to improve sericulture in East Pakistan is discussed. Irradiation of silkworms can stimulate growth, as has been shown by low dose (100-400 R) irradiation of 5th-instar larvae, when more silk was produced. Hot air treatment for killing pupae inside the cocoon injures the silk, and it is envisaged to replace it by γ-irradiation which also preserves cocoons for a much longer period; this also allows the ends of the fibre to be located more easily. Mutations induced by ionizing radiations can be developed to improve commercial varieties of silk. Radiation treatment by its effects on the colloidal properties of sericin can lead to better commercial grading. The production of eggs which permit sex differentiation by colour in new mutant strains as reported elsewhere more than 15 years ago, and the subsequent rearing of males only involves important economies.

2.4.5. Biological Control

1710 Cantwell, G.E., Franklin, B.A. INACTIVATION BY IRRADIATION OF SPORES OF Bacillus thuringiensis VAR. thuringiensis. J. invertebrate Path. 8, 2 (1966) 256-258.

Spores of B. thuringiensis var. thuringiensis on filters or glass slides were exposed to u.v. light, γ-radiation or sunlight. All treatments had deleterious effects. Nearly 50% of the spores were inactivated by exposure for 30 min to sunlight at temperatures of 70-92°F. Irradiation effects might explain some of the discrepancies between laboratory and field tests of biological control of pests with B. thuringiensis. (RAE-A 55: 1967, 71)

1711 Smirnoff, W.A., Cantin, M. EFFECT OF GAMMA IRRADIATION ON THE GROWTH RATE OF SPECIES OF Bacillus cereus GROUP. J. invertebrate Path. 9, 3 (1967) 357-363.

Results are presented of experiments on the influence of γ-irradiation on the growth, in vitro, of six entomopathogenic varieties of the Bacillus cereus Group. Growth of all six varieties was inhibited in the range, 228 280 to 456 560 rad and suppressed at 500 000 rad and over. Bacillus thuringiensis var. entomocidus was the most sensitive. Up to 500 000 rad, no modification in sporulation and crystal formation appeared; the only observable change was the time required for lysis, which increased as the dose increased. (Auth.)

See also:

1298 x-ray response of an endoparasitic wasp. (Ducoff, H.S., 1966)
1581 Use of alternative biological control schemes. (Horber, E., 1966)
1768 Cockroach control, past present future. (Burden, G.S., 1967)

2.4.6. Disease Control

1712 Dame, D.A. et al. CENTRAL AFRICA. I. THE USDA RESEARCH TEAM FOR THE CHEMO-STERILIZATION OF TSETSE FLIES. II. THE RADIO-STERILIZATION OF TSETSE. (2 PAPERS). Annual Report of the Agricultural Research Council of Central Africa. 1965. n.p.

The effects of tepa, metepa and γ-radiation on longevity, viability and reproductive potential are compared.

1713 McDuffie, W.C., Weidhaas, D.E. CURRENT RESEARCH BY THE USDA OF POTENTIAL SIGNIFICANCE TO WORLD-WIDE MOSQUITO CONTROL. Mosquito News 27, 4 (1967) 447-453.

Review of the possible used of insecticides, biocontrol, repellents, attractants, and sterilization in mosquito control.

1714 Weinbren, M.P. ANNUAL REPORT 1965. TERRESTRIAL ECOLOGY PROGRAM II: RADIATION-INDUCED VARIABILITY IN INDIGENOUS ARTHROPOD-BORNE ANIMAL VIRUSES OF PUERTO RICO. p. 147-148 of "Annual Report, 1965". PRNC-82, Puerto Rico Nuclear Center, Mayaguez. 225p.

The programme is designed specifically to study the effects on natural virus cycles (arthropod-borne viruses, especially Arbovirus) in γ-irradiated portions of the tropical rain forest.

See also:

1588 Eradication of the screw worm fly: an agent of myiasis. (Baumhover, A.H., 1966)

2.4.7. Miscellaneous (Radiation and Pest Resistance. Radiation Effects on Pesticides. Radiation Protection. Etc.)

1715 Affeltranger, C.E., Neel, W.W. EVALUATION OF RADIATION-PROCESSED WOOD-PLASTIC COMBINATIONS AGAINST SUB-TERRANEAN TERMITE ATTACKS. p. 57-61 of "Proceedings of the 2nd Workshop on Termite Research, Biloxi, Miss., USA, 8-10 Nov. 1965". Washington D.C., National Research Council. 1966, 109p.

Results of laboratory and field studies are reported. They indicate that radiation-processed wood-plastic combinations (produced by applying γ-radiation from a ^{60}Co-source to wood previously impregnated with a liquid monomer, the result being to initiate polymerization and to produce a plastic-reinforced wood that is stronger and harder than natural wood) possess considerable resistance to attack by Reticulitermes flavipes. This is true of impregnation with methyl methacrylate or Taylor's solution (30% methacrylic acid and 70% methylacrylate), whereas impregnation with polyvinyl acetate confers considerably less resistance. (Based on RAE-A 55: 1967, ref. 796.)

1716 Boldyrev, M.I. Thomasiniana ribis Mar. AND ITS ERADICATION. Izv. timiryazev. sel'.-khoz. Akad. No.4 (1966) 151-165. (In Russian)

On p.163, it is pointed out that the application of γ-rays from a ^{60}Co-source appears promising for the protection of cuttings. At the doses used (300-1000 R) the cuttings were not injured. Disinfestation by irradiation was directed against Thomasiniana ribis Mar.

1717 Dzhagatspanyan, R.V., Drobiz, A.M. UTILIZATION OF VARIOUS RADIOISOTOPIC DEVICES AND METHODS IN THE OIL AND CHEMICAL INDUSTRIES. CONF-641024-12. "Symposium on Use of Radioisotopes". Warsaw, Poland, n.d., 23p.

Radioisotopes are used in measurement and control equipment, as tracers, and for inducing chemical reactions. They have also been used to evaluate the amount of the γ-isomer in hexachlorocyclohexane, which determines its insecticidal properties, and to monitor the production of Metafos.

1718 Dzhagatspanyan, R.V., Zetkin, V.I. EINIGE REAKTIONEN DER ORGANISCHEN CHEMIE UNTER DEM EINFLUSS VON KERNSTRAHLUNG. (Some reactions in organic chemistry under the influence of nuclear radiation.) Chem. Wiss. Ind. 4 (1959) 761-769. (In Russian)

Industrial applications of nuclear radiation in connection with some chemical processes are outlined. The production of gammexane ($C_6H_6Cl_6$) by radiation-induced chlorination and sulphoxidation of hexanes by means of γ-radiation from a ^{60}Co-source are among them.

1719 Gavrila, V., Jurubescu, V., Alexe, G., Holerca, J. BIOSTIMULATIVE EFFECT OF IRRADIATED CHRYSALIS MEAL ON PIGLET DEVELOPMENT. Lucr. stiint., CVII (1964) 451-454. (In Rumanian)

Feed supplemented with an irradiated industrial meal including silkworm pupae administered to piglets in progressive doses (starting with 0.50 cg/kg bodyweight) stimulated their growth and development rate. The supplement administered to a 1st lot resulted in a 6 kg gain, on the average, while the average daily gain in the 2nd lot was of 60-70 g, as against the controls. The treatment was more efficient during winter than in summer. The ten months observation period showed that the gilts of the 1st lot had 9 to 14-strong litters (as compared with the 6 to 9-strong litters of the controls) and that newly born piglets registered higher birth weights. (Auth.)

1720 Lippold, P.C., Bourke, J.B., Massey, L.M. FURTHER STUDIES ON EFFECTS OF COBALT-60 RADIATION ON PESTICIDES. Bull. ent. Soc. Am. 13, 3 (1967) 192. Abstr. 110. Presented at "New York Meeting of the Entomological Society of America. New York, N.Y., USA. 27-30 Nov. 1967".

Degradation of a number of pesticides were obtained at doses of 0.1-5.0 Mrad. Changes were evident with pesticide solvent standards as well as extracts of treated crops. Chromatographic and biological analyses were employed to analyse solutions. Decreases in concentration followed a 1st-order reaction. (Abstr.)

1721 Neel, W.W., Affeltranger, C.E., Beal, R.H. RADIATION-PROCESSED WOOD-PLASTIC COMBINATIONS CURB SUBTERRANEAN TERMITE ATTACKS. Pest. Contr. 34, 7 (1966) 39-40.

Treated and untreated blocks of maple, birch, and white pine measured 1 in. × 1 in. × 3 in. Radiation from a ^{60}Co-source replaces the activating agent (chemical catalyst) ordinarily used to bond the plastic molecules. Radiation activates the monomers (plastics) themselves, so they join together or polymerize. The treatments consisted of: (1) irradiated blocks impregnated with (a) vinyl acetate, (b) methyl methacrylate, and (c) 30% methacrylic acid and 70% methyl methacrylate of different castes; (2) irradiated control blocks; and (3) untreated control blocks. — 8 to 10 replicates of each treatment were used. Each block, in a sterile jar with its sand contents, was exposed to approximately 500 worker termites, Reticulitermes flavipes. The jars were kept in an incubator at a constant temperature of 77°F and 90% relative humidity. The laboratory results (Table 1) reveal that termite attack, reflected by weight loss, is less for wood treated with the mixture of methacrylic acid and methyl methacrylate. Second most effective is methyl methacrylate, and the least effective is vinyl acetate. The average weight loss of the maple blocks impregnated with vinyl acetate was almost as much as the weight lost in the irradiated and the untreated control blocks. Results of the field tests showed that methyl methacrylate stakes had fewer termite attacks than the vinyl acetate stakes. There was a direct correlation between termite attack and wood decay in each series treated. Some resistance to termite attack may be deduced from the monomer treatment. The length of this resistance over extended period of time is being investigated.

1722 Reistrup, J.V. BEES MAY HELP TO BLUNT STING FROM RADIATION. Washington Post Dec.16 (1966) n.p.

Newspaper article. Protection results from venom-induced stress or free radical scavenging.

1723 Shipman, W.H., Cole, L.J. INCREASED RADIATION RESISTANCE OF MICE INJECTED WITH BEE VENOM ONE DAY PRIOR TO EXPOSURE. USNRDL-TR-67-4, Naval Radiological Defense Lab., San Francisco, Calif. 20 Dec. 1966, 19p.

Mice were injected with bee venom dissolved in a 0.90% NaCl solution. This injection was given either intraperitoneally or subcutaneously 24 h before the mice were irradiated with x-rays. It was found that, after exposure to a lethal dose of radiation (800-850 R) the venom-injected mice had a consistently higher number of survivals than the controls, and that the subcutaneously-injected mice had a higher number of survivals than the intraperitoneally-injected mice. The question as to whether this radioprotective effect of bee venom is due to its general stress-like effect, or to the action of a specific chemical component was discussed. (Auth.)

1724 Tsochev, T.N. BIOLOGICAL PROPHYLLAXIS OF ACUTE RADIATION DISEASE WITH LYOPHILIZED ROYAL JELLY. Eksp. Med. Morfol. 3 (1964) 219-223. (Bulgarian? Russian?)

Studies using the lyophilized Bulgarian royal jelly apitonin and cystamine chloride in 280 rats irradiated with LD 90 to LD 100 (750-850 R) revealed that a dose of 0.8-1 g/kg daily for 6 d (with irradiation on day 3) protected rats more effectively than an optimal (nearly toxic) dose of cystamine; 55% survival ($p < 0.05$), compared with 50% for cystamine. Only 10% of the untreated controls survived. (NSA 19: 1965, 19629)

3. ADDENDUM

3.1. TECHNIQUES

3.1.1. Autoradiography

1725 Paul, J.S. QUANTITATIVE BIOPHYSICAL AND CYTOCHEMICAL STUDIES OF POLYTENE CHROMOSOMES. Diss. Abstr. 27, 1 (1966) 45-B - 46-B.

Quantitative studies on the cytochemical and cytophysical properties of the polytene chromosomes of the salivary gland (1st, 2nd, and 3rd instar) of Drosophila melanogaster were undertaken using interference microscopy and microspectrophotometry in order to elucidate some aspects of fundamental chromosome structure. The refractive indices of nucleoplasm, nuclei, bands and interbands of distal and proximal salivary glands and Malpighian tubules of the 3rd-instar larvae were determined. A new method of automated autoradiograph grain counting was developed. This method was characterized by its extreme accuracy and rapidity, even for small areas within a single cell. It was applied to labelled (in vivo) 3rd-instar salivary glands. A lessening of the rate of incorporation of isotopes with increasing ploidy was observed. Among the experiments carried out were the extraction of salivary chromosomes with DNase, and RNase; treatment of chromosomes with trypsin and pepsin; removal of DNA and RNA with trichloroacetic and perchloric acid; cold shock applied to larvae; and densitometric studies. RNA concentrations in the puffs of living salivary gland cells were found to be not much higher than those in some bands; the total volume was, however, much higher due to the large volume. Quantitative cytochemical studies by microspectrophotometry were performed and correlated with interference microscopy. The data obtained from combined interferometric and microspectrophotometric studies indicated that DNA was present in both bands and interbands. RNA was present in variable degrees in certain bands. The absolute mass was greater in the bands than in interbands. The distribution of DNA did not correlate, on a proportional basis, with the protein distribution. It was, therefore, evident that simple coiling of the chromonemata could not entirely explain the distribution of nucleic acids and protein. The interband regions appeared to contain high levels of non-histone proteins which were probably not directly associated with the nucleohistone component.

1726 Salpeter, M.M. ELECTRON MICROSCOPE RADIOAUTOGRAPHY AS A QUANTITATIVE TOOL IN ENZYME CYTOCHEMISTRY. I. THE DISTRIBUTION OF ACETYLCHOLINESTERASE AT MOTOR END PLATES OF A VERTEBRATE TWITCH MUSCLE. J. Cell Biol. 32, 2 (1967) 379-389.

^{3}H-diisopropylfluorophosphate (DFP) was used to phosphorylate acetylcholinesterase (AChase) in the motor end plate of mouse sternomastoid muscle, and its distribution within the end plate was evaluated quantitatively by electron microscope radioautography. With the use of emulsion layers whose sensitivity to ^{3}H had been calibrated, the density of AChase in different components of the end plate was calculated. The AChase was primarily localized (85%) in the junctional fold region. The concentration of AChase there was more than 20 000 active sites per cubic micron of tissue. The resolution of the technique was not sufficient to determine whether there was some AChase in the nerve end bulb; however, if there is any there, the concentration must be less than 10% of that at the junctional fold region. (Auth.)

See also:

275 Influence of the physical state of chromatin on nucleic acid and protein synthesis and on radiation sensitivity of cell division. Progress report. (Gaulden, M.E., 1967)

455 Application of the autoradiographic technique to the study of the excretion in the coleopterous insect Tenebrio molitor L. (Marcuzzi, G. et al., 1964)

572 Radiometric detection of exposure to insecticides. (Disney, R. W., 1965)

663 Application of radiochemistry techniques in food processing research. Radioisotopic tracer techniques in evaluation and improvement of industry practices for removal of pesticide residues from foods. Annual report No. 4. (Mercer, W. A., Ed., 1964)

671 Use of radioisotope techniques to detect and measure pesticide residues in and on foods and to evaluate commercial food preparation practices. (Ralls, J. W., 1965)

1791 "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology, Gainesville, Fla., 4 Oct. - 26 Nov. 1965". (International Atomic Energy Agency, Vienna, Austria et al., 1965)

3.1.2. Dosimetry

1727 Roti Roti, J. L., Kaye, S. V. CALIBRATION OF $^{90}Sr + {}^{90}Y$ PLANES FOR IRRADIATING INSECTS. ORNL-TM-1921, Oak Ridge National Lab., Tenn. 18 Jul. 1967, 22p.

Calibration dose-rate measurements were made above two 34 cm diameter plane-disk sources containing approx. 75 mCi and 750 mCi of $^{90}Sr + {}^{90}Y$, respectively. The contact dose rate in the centre of the 75 mCi source was 656 rad/h and the measured dose rate at contact in the centre of the 750 mCi source was 4950 rad/h. The data presented are intended to be useful in the planning of experiments for investigation of the effects of radiation on insects. (Auth.)

1728 Schlagbauer, A. EINE RATIONELLE MESS- UND AUSWERTUNGSMETHODE ZUR ERFASSUNG DER BIOLOGISCHEN HALBWERTSZEIT VON RADIOISOTOPEN UND IHRE ANWENDUNG IN DER ENTOMOLOGIE. (A rational method of measurement and evaluation for the determination of the biological half-life of radioisotopes, and its application in entomology.) Int. J. appl. Radiat. Isotopes 18, 8 (1967) 595-603. (In German, with English, French and Russian summaries)

The decay curves were determined from measurements of the pulse rate of radioactively labelled compounds on live insects by means of a FORTRAN 7090 computer programme. The biological half-lives are thence calculated on the basis of formulae which are given. An exact mathematical method with rational data processing produced reproducible results. The method was tested with various kinds of bugs, including Pyrrhocoris apterus L., Rhinocoris iracundus Pd., and Oncopeltus fasciatus Dall., using ^{32}P, ^{86}Rb, and ^{131}I. Water bugs (Notonecta glauca L., Corixa punctata Ill., Gerris lacustris (L.)) secrete the tracers used more quickly than bed bugs. For phosphate and iodide the biological half-life for bed bugs amounted to about 50 d and for water bugs to 3 d. Half of the rubidium chloride, on the other hand, was eliminated by bed bugs within 1½ d.

3.1.3. Isotope Dilution

1729 Bogner, R. L. DEVELOPMENT OF DOUBLE ISOTOPE DERIVATIVE ASSAYS FOR MEASUREMENT OF PESTICIDE RESIDUES. p. 67-77 of "Radioisotopes on the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria). 1966, 118p.

A discussion on the principles of radioisotope dilution procedures and the development of double isotope derivative analysis for pesticide residues, such as DDT and dieldrin. (CA 68: 1968, 20979h)

See also:

1737 Development of double isotope derivative dilution analyses for selected food additives. Final Report. (Bogner, R. L. et al., 1963)

3.1.4. Labelled Pool Technique

See :

307 Formation of tritium pools during mitosis. (Leach, W.M., 1964)

3.1.5. Neutron Activation Analysis

1730 Bogner, R.L. POTENTIAL OF NEUTRON ACTIVATION ANALYSIS OF PESTICIDES AND METABOLITES. p. 78-89 of "Radioisotopes on the Detection of Pesticide Residues. Proceedings of a Panel. Vienna, Austria. 12-16 Apr. 1965". STI/PUB/123, International Atomic Energy Agency, Vienna (Austria). 1966, 118p.

The special merits and limitations inherent in activation analysis procedures as they apply to pesticide analysis are reviewed. The technique is admirably suited for the measurement of pesticides containing Hg, As, Cl, Br, Zn, and Cu. The combination of chromatographic separation with neutron activation, particularly of activatable derivatives, greatly extends the scope of activation technique. Tracer studies dependent upon activation analysis are potentially valuable for several varieties of pesticides provided that non-radioactive or quasi-stable isotopes of the elements of interest are available in highly enriched forms.

1731 Buchanan, J.D., Guinn, V.P. ANALYSIS OF FOODS BY NEUTRON-ACTIVATION TECHNIQUES. Fd Technol. 17 (1963) 17-22.

A most useful application of neutron activation to the analysis of foods has been in determination of chlorinated or brominated residues in foods. The chlorinated pesticides that have been determined include DDT and toxaphene. Generally, the analyses have been performed on organic extracts, which have been used to separate these insecticides from inorganic chloride and from other elements (principally Na and Mn) whose activation products would tend to mask ^{38}Cl in the γ-ray spectrum of the activated sample. Small amounts of Na and Mn are often seen, even in the organic extracts, and electronic subtraction of their contribution to the observed γ-ray spectrum is used to minimize their interference with the chlorine determination. Total Br concentration has been used as a measure of residual amounts of methyl bromide in wheat, wheat products, walnuts, lentils, and spices.

1732 Fourcy, A. LES APPLICATIONS DE L'ANALYSE PAR ACTIVATION AUX PRODUITS AGRICOLES ET ALIMENTAIRES. Bull. Inf. Sci. Tech. No. 99 (1965) 57-70.

Various potential uses of activation analysis are indicated, among them efficacity studies of pesticides and analysis of pesticide residues.

1733 Fourcy, A. BIOLOGY AND NEUTRON RADIATION: AGRONOMICAL APPLICATIONS OF RADIO-ACTIVATION ANALYSIS. Inds atom. 11 (1967) 11-12; 39-46.

The general method of neutron activation is outlined, including preparation of organic samples and radiochemical separation. Elements utilised in agronomy studies are Cl, Mn, Na, As, W, Mo, Co, Fe, Zn, Rb, Cs, Ca, Sr, Ba, Sc, Ru, Mg, P, Si, Al, F, and the lanthanides. More specific studies are outlined in the areas of the physiology of mineral nutrition, trace element analyses of vegetable matter, pesticide residues, industrial pollution, and indication of radioactive pollution. (CA 68: 1968, 57328w)

1734 Guinn, V.P. ACTIVATION ANALYSIS. Encycl. Ind. Chem. Anal. 1 (1966) 52-77.

A review on this method of elemental analysis that is based on nuclear reactions, including types of nuclear particles employed (neutrons, charged particles, and photons), neutron sources, theory, radioactive decay schemes, x-ray spectrometry, experimental procedures, statistical considerations, the speed, precision and accuracy, sensitivity, and errors of the method, and applications in the determination of O, analysis of high-purity materials for trace impurities, determination of pesticides in food, and applications in the petroleum, chemical, rubber, and plastics industries. (CA)

See also:

665 The determination of chlorinated hydrocarbons in the atmosphere by activated analysis. (Morgan, D.J. et al., 1965)

3.1.6. Miscellaneous (including Radiography)

1735 Andrews, F.N., Christian, J.E. THE LARGE VOLUME LIQUID SCINTILLATION DETECTOR AND ITS USE IN STUDYING THE PHYSIOLOGY, GENETICS AND NUTRITION OF FARM ANIMALS. p. 189-198 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1". New York, Academic Press. 1962.

A large volume 2-π liquid scintillation detector, Sinco-P, was constructed at Purdue University under a grant from the Atomic Energy Commission. This instrument is capable of measuring extremely low level γ-activity of large inanimate objects and live animals weighing up to 250 lb. The detector is also being used in connection with isotopes such as ^{22}Na, ^{42}K, ^{131}I, ^{60}Co, ^{59}Fe, ^{137}Cs, ^{134}Cs, and other γ-emitters. It can play a vital role in the measurement of radioactivity in animal feedstuffs and human food, is of value in studying residue problems involving insecticides, herbicides and pesticides in general, and in studying intermediary metabolism in properly labelled drugs. (From auth.)

1736 Berryman, A.A. ESTIMATION OF Dendroctonus brevicornis (COLEOPTERA: SCOLYTIDAE) MORTALITY CAUSED BY INSECT PREDATORS. Canad. Ent. 99, 10 (1967) 1009-1014.

Laboratory and field experiments were designed to determine the effect of insect predators on immature broods of D. brevicornis LeConte. Twenty pieces of ponderosa pine bark, each ~40 sq.in., were selected from a large number of samples from trees infested with Dendroctonus. Samples were chosen to include as many different densities of predator and prey as possible. The bark samples were radiographed 4 times in 2 weeks. In the field 6 trees containing first generation Dendroctonus broods were sampled, by removing 4-in. wide circumferential bark strips every 5 ft up the infested bole and repeating at ~10-d intervals. A total of 366 was collected and the number of beetle and predator larvae determined radiographically for each sample. Data were analysed by graphical and regression methods. The results indicate that predation is dependent on the predator density and the time predator and prey are exposed together. Prey density was generally very high and had little effect on the rate of predation. The corroboration of laboratory and field experiments give confidence to the conclusion that the constant predation rate (0.261 prey/predator/d) can be used to estimate western pine beetle mortality from predation, provided temperatures remain within the 60° to 70°F range.

1737 Bogner, R.L., Domek, N.S., Eleftheriou, S., Ross, J.J., Jr. DEVELOPMENT OF DOUBLE ISOTOPE DERIVATIVE DILUTION ANALYSES FOR SELECTED FOOD ADDITIVES. Final Report. NSEC-85, Nuclear Science and Engineering Corp., Pittsburgh, Pa. 15 May 1963, 105p.

Results of initial investigations designed to demonstrate the feasibility of double isotope derivative dilution analyses for selected chemical residues in foods are presented. Four compounds were selected as representatives of commonly employed pesticides of different chemical structures that would necessitate the exploration of a variety of isotope derivative procedures. In this way, it was anticipated that the feasibility of radioisotope procedures could be demonstrated and further investigations of the techniques could be stimulated. The four pesticides studied were DDT, dieldrin, systox, and diazinon. A double isotope derivative dilution analysis for DDT was devised based on the tetranitration of DDT and added ^{14}C - DDT, subsequent formation of the dianilide derivative with ^{3}H-aniline, purification of the double-labelled derivative by paper chromatography, and simultaneous counting of the ^{3}H - and ^{14}C - content of the derivative in a liquid scintillation spectrometer. One- to 10-μg quantities of DDT were determined by using ^{14}C-DDT and ^{3}H-aniline of specific activities which are readily available and easily prepared. Simultaneous determination of DDE is discussed and the expected advantages of the isotope dilution procedure are reviewed. Dieldrin was shown to be amenable to analysis by a double isotope derivative dilution procedure which involved derivatization of dieldrin and ^{14}C-dieldrin with ^{3}H-acetic anhydride to form a double-labelled derivative and purification by multiple recrystallizations with carrier non-labelled dieldrin

derivative. A potential isotope derivative procedure for systox was suggested by the demonstration that hydrolytic cleavage of the thiono and thiol isomers yielded β-hydroxydiethyl sulfide and β-mercaptodiethyl sulfide, respectively, which could be derivatized with dinitrobenzoyl chloride, a reagent that can readily be ^{3}H-labelled. (Auth.)

1738 Bourke, J.B., Faust, M., Massey, L.M., Jr. A MULTIPLE UNIT RADIOMETRIC RESPIROMETER FOR THE MEASUREMENT OF THE METABOLISM OF ^{14}C LABELLED SUBSTRATES. Int. J. appl. Radiat. Isotopes 18 (1967) 619-623.

An improved radiometric respirometer is described which permits periodic sampling of both the evolved $^{14}CO_2$ and the activity remaining in the substrate solution, as well as the complete recovery of added radioactivity. The system, although described for use with plant tissue may be used with insects or small animals. A procedure for the use of the system is described, and a typical experiment utilizing irradiated carrot tissue is discussed. (Auth.)

1739 Eldefrawi, M.E. LIQUID SCINTILLATION COUNTING OF ^{3}H AND ^{14}C COMPOUNDS IN ANIMAL TISSUES. Analyt. Biochem. 17 (1966) 353-355.

A procedure using nitric acid for tissue digestion is described, which gives a high counting efficiency for ^{3}H and ^{14}C water-soluble non-volatile compounds. This technique was applied to small pieces of different tissues from the rat and the American cockroach, including the rat skin and roach cuticle. The counting efficiency for ^{3}H ranged from 9.3 - 11% compared to 12.5% for counting ^{3}H standards in Bray's dioxane cocktail, and was 60% for ^{14}C, which is the max. efficiency obtained with ^{14}C in this cocktail. Increasing the amount of rat brain and roach muscle hardly affected the counting efficiency of ^{14}C but ^{3}H counting efficiency was reduced by increasing the amount of tissue. (NSA 21: 1967, 5809)

1740 George, J.A., Howard, M.G.A. WAXED-PAPER LABORATORY CAGE FOR STERILIZATION STUDIES WITH THE ORIENTAL FRUIT MOTH, Grapholitha molesta (Busck) (LEPIDOPTERA: TORTRICIDAE). Proc. ent. Soc. Ont. 95 (1964) 146-147. Published 1965.

Females of G. molesta deposit eggs readily on waxed paper. The construction of a very satisfactory yet simple cage from wax paper is described in detail. The moths are introduced or removed through a hole in the cage by aspirator. Cages of various sizes can be made for accommodating different numbers of insects. Various ratios of males to females can be replicated without a change in the density of the moths. A satisfactory method for collecting all eggs over the lifetime of a female was needed for testing the effects of γ-radiation and chemosterilants on the fertility and vitality of the moth. The collected eggs are incubated for 3 d in a warm humid atmosphere, and the number of eggs hatched determined subsequently. Optimum conditions that can be replicated are provided for the mating and max. longevity of adults. By using transparent waxed paper dead moths could be detected and removed daily.

1741 Hayes, T.L., Pease, R.F.W., Camp, A.S. STEREOSCOPIC SCANNING ELECTRON MICROSCOPY OF LIVING Tribolium confusum. J. Insect Physiol. 13 (1967) 1143-1145.

The scanning electron microscope has been used to produce stereoscopic pictures of living T. confusum at magnifications up to 1300 times. The physiological implications of survival in the environment of electron beam scanning are discussed. Larval, pupal, and adult forms are capable of surviving the vacuum and the electron beam bombardment involved in the scanning. Local elevation of temperature due to the bombardment has been estimated as only 0.005°C but the dose rate of ionizing radiation may reach 10^{7} rad/sec. Observations times of ~ ½ h were tolerated. 25 keV electrons and a beam current of ~ 10^{-11} A were used.

1742 Kamra, S.K. DETECTION OF MECHANICAL DAMAGE AND INTERNAL INSECTS IN SEED BY x-RAY RADIOGRAPHY. Svensk. bot. Tidskr. 61, 1 (1967) 43-48.

Fourteen species of agricultural seed were used. The external mechanical damage to seed (e.g. cracks or breaks in the testa, etc.) as well as the internal mechanical damage (to parts enclosed by the seed coat) could be seen on x-ray pictures. The radiographs revealed the occurrence of larvae (or adult insects) and/or holes bored by them in the seeds. Thus, larvae of Trogoderma granarium Ev. in Triticum aestivum were clearly seen in some cases. Sometimes only the

empty coat was left. Tunnels bored into seed (Lens esculenta) by larvae of Bruchus sp. are distinctly visible. A few adults have also been seen in some cases. In Phaseolus mungo, most of the seeds were seen to show big holes, some containing insects (Bruchus sp.). Various views of tunnels bored by members of the Bruchus sp. were also observed in P. aureus and Cicer arietinum. Larvae of different sizes (Bruchus sp.) were visible in Vicia faba, sometimes in the same seed. Many seeds of Triticum aestivum were found to contain larvae of Sitophilus granarius. Illustrations of the above are given. - The radiographical method can evidently be reliably used for detecting mechanical damage and internal insects in seed. Various other uses and advantages of the method, which make it suitable for routine seed testing and research are pointed out. Soft x-rays (Grenz rays) were used: kV = 14, mA = 10, focus 25 cm, 6 sec-exposures, with x-ray industrial film type L (CEA works, Strängnäs, Sweden).

1743 Kovoor, J. ETUDE RADIOGRAPHIQUE DU TRANSIT INTESTINAL CHEZ UN TERMITE SUPERIEUR. Experientia 23, 10 (1967) 820-821. (With English summary)

Termites (Microcerotermes edentatus Wasmann, Amitermitinae) were fed some $BaSO_4$, and were subsequently exposed to x-rays. It was possible to study the animals continuously for 24 and even 48 h. Intestinal transit is greatly influenced by variations in temperature and humidity, accelerating with rising temperature. Intestinal transit normally lasts ~24 h. It is uni-directional and rapid up to the 1st pouch of the hindgut. The 2nd pouch, which takes up to 8-12 h to traverse, is undoubtedly equivalent to the "rectal pouch" of the lower termites.

1744 Lippold, P.C. AN IMPROVED TUBE CLOSURE FOR BIOLOGICAL TESTS. J. econ. Ent. 59 (1966) 626-628.

Plastic industrial-machine closures were modified to substitute for conventional rolled cotton plugs in bioassay tests. This plastic plug with a cotton dental-wick insert was found to provide a more effective seal of tubes, and enabled adult Drosophila melanogaster Meigen to be held for longer exposure periods with significantly less natural mortality. In disulfoton evaluation tests, greater mortality of Drosophila was obtained in tubes stoppered with plastic caps as opposed to cotton plugs. This increased activity, resulting from more effective closure and possible fumigant action, indicated increased sensitivity could be obtained with compounds where vapour pressure must be considered. These plastic caps were non-toxic and not repellant to adult flies, as indicated in feeding uptake studies using Karo solution fortified with ^{32}P. * The many advantages and versatility of this type of closure should result in its adoption in numerous applications. (Auth.)

* in the form of 1.0 µCi of carrier-free $H_3{}^{32}PO_4$ /ml of solution.

1745 Lippold, P.C. PLASTIC ENCLOSURES FOR IN VIVO RADIOASSAY OF INSECTS. Int. J. appl. Radiat. Isotop. 18, 9 (1967) 656-658.

Plastic planchet covers, as well as custom "form-fitted" covers were moulded* for immature and adult insect stages. Data indicated that plastic covers or moulds could be successfully employed with insects labelled with ^{32}P or more energetic radionuclides. Thus, a reduction in numerical counts of 22-34% was encountered in covered ^{32}P-labelled insects. Counts of ^{14}C, with a max. β-ray energy of only 0.155 MeV as compared with 1.707 of ^{32}P, dropped to an insignificant level. ^{137}Cs, with β-ray energies of 0.514 and 1.2 MeV; γ-rays of 0.622 MeV were not affected. Thickness of plastic enclosures approximated 33 mg/cm^2.

* Vac-U-Form Molding Kit; Mattel, Inc., Toymakers, New York City. - Approx. cost. $16.00.

1746 Malich, C.W. THIN WINDOW HOLDER FOR PARTICLE IRRADIATION OF Drosophila. Drosoph. Inf. Serv. 40 (1965) 99.

A simple holder has been devised which makes irradiation convenient and uniform for particles having ranges between a few mm and a few cm. The construction is described in some detail. The thick lucite construction is adequate for most particle irradiations. The nuclear properties of H^1 and C^{12} minimize neutron production and bremsstrahlungen, and tests have shown that such secondary reactions contribute less than 1% to the dose in these holders. It is important to have the diameter of the window larger than the beam, so that forward scattering will not contribute to the dose. A double thin window holder has been constructed for comparison, and is preferable for highly

penetrating radiations. The double window design is also better for use with x-rays, since the back scatter from thick lucite significantly increases the dose absorbed from the incident radiation and its effective linear energy transfer. We are developing a more sophisticated design which will improve ventilation, increase compression of the flies and permit partial body irradiation. This should be useful with UV as well as charged particles, but the simplicity of the present design makes it preferred for routine work.

1747 Oatley, C. W., Nixon, W. C., Pease, R. F. W. SCANNING ELECTRON MICROSCOPY. Adv. Electronics Electron Phys. 21 (1965) 181-247.

The principle of the instrument consists of focussing an electron beam on the surface of a specimen, the diameter of the beam, after passing through several electron lenses, being ~100 Å. A portion of the current leaving the specimen is collected by a plate and conveyed to an amplifier, and hence to a cathode ray tube. The principles of design (schematic arrangement, fundamental limitations, factors affecting contrast, effects of electron penetration on the specimens, and practical limits of resolution (in practice ~200 Å for average specimens) are discussed, followed by a section on techniques and applications. The examination of biological materials is described. Direct examination is possible without any change in appearance of the specimen when the cell walls remain unbroken on being placed in a vacuum. Photos are shown of the ocelli at the vertex of a fly's head, the compound eye of Musca domestica, and a bristle on Tenebrio molitor at 20 000 X magnification). Under suitable conditions, a more readily interpreted 3-dimensional image may be obtained than in the ordinary transmission electron microscope, while using a very much smaller mean current density.

1748 Pease, R. F. W., Hayes, T. L., Camp, A. S., Amer, N. M. ELECTRON MICROSCOPY OF LIVING INSECTS. Science, N. Y. 154 (1966) 1185-1186.

A scanning electron microscope, in which the electron current is very much lower than in the conventional electron microscope, was used. Electron micrographs of living specimens of the various developmental stages of Tribolium confusum have been obtained. Samples of eggs, larvae, pupae, and adults were kept for 30 min in a chamber evacuated to a pressure of 10^{-3} torr; all developmental stages survive this vacuum. Periods of exposure to the vacuum and to the electron beam in the scanning microscope ranged from 2 min to 1 h. The electron current ranged from 2×10^{-11} to 2×10^{-10} amp, at an electron energy of 25 keV. The magnification used here was only 670 times but can certainly be increased a great deal where necessary. The possibilities of the system are discussed. The energy or current could be raised, so that the biological effects of irradiation on selected areas as small as 10^{-6} cm^2 in living specimens could be studied.

1749 Pesson, F. P., Ozer, M. APPLICATION OF AN ACTOGRAPHIC RECORDING METHOD TO THE STUDY OF THE EFFECTS OF IRRADIATION ON Calandra granaria LARVAE. Fd Irrad. 6, 1-2 (1965) A15.

G. Busnel, Director of the I. N. R. A. "Laboratoire de la Physiologie acoustique à Jouy-en-Josas" has constructed an apparatus for us that enables the noise made by Calandra larvae to be picked up by a microphone, followed by amplification and continuous recording. The apparatus is sufficiently sensitive to record the activity of a single larva in a grain of wheat. Only preliminary tests have so far been performed. Over three consecutive weeks, we have recorded the activity of a larva from hatching to emergence of the adult. We have also compared the activity of larvae before and after irradiation. In this way it is possible to assess the effects of irradiation immediately after exposure, and at varying intervals of time thereafter. The lethal effects of the doses used can thus be rapidly determined, without incubating the irradiated wheat and waiting for any adults to emerge. Results of these experiments are in press.* (Cited verbatim)

* (1965)

1750 Robbins, J. D., Bakke, J. E. A METHOD FOR COLLECTING $^{14}CO_2$ FROM A HYDROGEN FLAME DETECTOR. J. Gas. Chromat. 5, 10 (1967) 525-526.

A method was developed for determining radioactivity in the effluent from a gas chromatographic column. The method permitted rapid determination of the radioactive metabolites from ^{14}C-labelled compounds, such as pesticides. Gases from an enclosed H flame detector are passed through

a 15-ml pipette coated with ethanolamine to trap $^{14}CO_2$ from labelled herbicides.* Recovery of $^{14}CO_2$ is 42-66% when tested with ^{14}C-labelled propazine (2-chloro-4,6-bis(isopropylamino)-s-triazine) uniformly ring labelled and previously passed through a column composed of 5% Carbowax 20 M or Chromosorb W at 210°C with N at 30 ml/min. (CA 68;1968, 766h)

* Applicable to other pesticides. (Comp.)

1751 Russel, M.P. RICE WEEVIL BIOLOGY AS AFFECTED BY GRAIN STORAGE CONDITIONS. Bull. ent. Soc. Am. 12 (1966) 279. Abstr. 322. Presented at "Portland Meeting. Portland, Oreg., USA. 28 Nov. - 1 Dec. 1966".

Six varieties of sorghum stored for periods of 6-16 yr, were infested with fixed numbers of the rice weevil, Sitophilus oryzae. The oviposition rate was measured by berberine staining and x-ray counts, and the number of emerging adults was noted. Relative grain hardness, not storage time, influenced the reproductive rate. (Abstr.)

1752 Smith, G.N. A SIMPLE METHOD FOR COMBUSTING TISSUES FOR CHLORINE-Cl^{36} ANALYSIS. Analyt. Biochem. 17, 1 (1966) 24-37.

A simple apparatus and method is described for the combustion of biological samples containing ^{36}Cl-labelled compounds. The samples are combusted in a mixture of nitric and sulphuric acids and the liberated chloride trapped as silver chloride, which can be dissolved and counted in a scintillation counting system. With these techniques it is possible to detect chlorine-labelled compounds with specific activity of 0.02 mM in concentrations of 0.02 to 0.05 ppm in tissue. (Auth. summary)

1753 Taimr, L., Ditlbek, J. ZJIŠTĚNÍ VHODNOSTI POUŽITÍ MIKRODÁVKOVAČE PRO TOPIÁLNÍ APLIKACI INSEKTICIDU NA BROUKY MANDELINKY BRAMBOROVÉ. (Determination of the suitability of a microdoser for topical application of insecticides to the Colorado potato beetle.) Věd. Pr. výzk. Úst. rostl. Výroby Praze-Ruzyni 11 (1967) 201-206. (In Czech, with Russian, German and English summaries)

The apparatus was tested for accuracy and suitability at the Central Research Institute for Plant Production at Prague-Ruzyne. A radiometric method was used for determining the drop size of the deposit of triolein-^{131}I oil solution amounting to 6.40×10^{-4} ml. The mean square error amounted to 1.90×10^{-5} ml. On the 3rd day after application of the triolein oil solution cleaning movements of the beetles had transferred 18.87% of the deposit to the hind pair of legs, 14.67% to the front and central pairs, and 1.41% to the antennae. At the original place of deposit only 65.05% of the substance remained.

1754 Wickman, B.E. USE OF RADIOGRAPHY TO DETECT MORTALITY OF CALIFORNIA FLATHEADED BORERS IN PINE BARK. J. econ. Ent. 59, 4 (1966) 1028-1030.

During a field test of lindane to control the California flatheaded borer, Melanophila californica Van Dyke, in Jeffrey pine, Pinus jeffrei Grev. and Balf., x-radiography was used to check for mature larval winter holdover in the bark after most of the insects had emerged. An attempt was also made to identify late larval-instar mortality. Bark samples ¼-1 in. thick were radiographed after adult emergence was completed. A General Electric LC-90 (set at 5 mA, 25-30 kVp, for 15 sec at 24 in. FD) and Kodak industrial-type AA x-ray film in ready packs were used. Dead larvae and pupae were easily distinguished on radiographs, and the results confirmed by dissection.

See also:

94 Control of crop emptying in the blowfly. (Gelperin, A., 1966)
576 Distribution measurements for testing new devices of insecticide and fungicide spreading. (Helbig, W. et al., 1967)
1526 Ecological methods with particular reference to the study of insect populations. (Southwood, T.R.E., 1966)
1703 Damage to biscuits caused by Lasioderma serricorne (F.) (and data on its biology as shown by radiographs). (Calderon, M. et al., 1960)
1704 Criteria for radiographic examination of internal insect infestation. (Freeman, C.C., 1965)

1706 Laboratory studies of the biology and behavior of the Angoumois grain moth, Sitotroga cerealella (Oliver). (Mills, R.B., 1965)

1706 Radiographic studies of Angoumois grain moth development in wheat, corn, and sorghum kernels. (Mills, R.B. et al., 1967)

3.2. BIBLIOGRAPHIES AND GENERAL SURVEYS

3.2.1. Bibliographies

1755 Binggeli, M.-H. RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY. VOL. III (1964-1965). International Atomic Energy Agency, Vienna (Austria). 1967, 454p. Bibliographical Series No. 24.

Fully annotated bibliography for the 2-yr period 1964-1965, a follow-up of the 2nd volume (Bibliographical Series No. 15) which covered the 3-yr period 1961-1963. Approximately 1100 references on radioisotopes and radiations in entomology from reports and articles in journals and books are given, complete with abstracts. Author and updated affiliations, subject, and insecticide indexes are given. A special feature of the subject index is the citation, alongside each reference, of the relevant radioisotope or radiation employed in the study. Of the 454p, a total of 76p is devoted to tables, consisting of (1) a systematic listing of insects and related arthropods, (2) lethal radiation effects, (3) sterilization data, and (4) radiotracer studies on insecticides.

1756 Deleted.

1757 Dedek, W. RADIOAKTIVE NUKLIDE IN DER CHEMIE DER PESTIZIDE (II). (Radioactive nuclides in pesticide chemistry. II.) Atompraxis 13, 3 (1967) 126-129. (In German)

Continuation of the literature review of 1964. The article contains 177 references dealing with surveys and analytical studies, and sections on ^{32}P-labelled substances (phosphates, phosphonates, thiophosphates and dithiophosphates), ^{35}S-labelled substances (thio- and dithiophosphates, fungicides, nematocides, and others), and halogen-labelled substances, especially ^{36}Cl-labelled substances (insecticides and herbicides).

1758 Franz, J.M., Simon, H.R. BIBLIOGRAPHIE CONCERNANT LA LUTTE BIOLOGIQUE. Entomophaga 12, 1 (1967) 5-80.

Continuation of bibliographical listing without abstracts, in separate sections, section 9 dealing with autocidal measures (p. 68-73); 129 references are cited, including work on chemosterilants. References in any one section are arranged alphabetically by senior author. For reference to earlier listings, see III/1054-5.

1759 Ingram, M. BIOLOGICAL EFFECTS OF IONIZING RADIATION. An Annotated Bibliography. TID-3097, Division of Biology and Medicine (AEC), Washington, D.C. Dec. 1966, 286p.

The 12 726 references, mostly with an abstract, are arranged numerically in the order in which they were collected. The subject index is of a hierarchial type consisting of general categories, each followed by one or more subdivisions. There is also an author index.

1760 International Atomic Energy Agency, Vienna (Austria). INFORMATION CIRCULAR ON RADIATION TECHNIQUES AND THEIR APPLICATION TO INSECT PESTS. No. 7. WP/31/7. May 1966. 49p.

The circular is aimed at disseminating research information to workers in the field. An author index is included in this circular which contains 5 review articles and 1 bibliography, 1 ecological study, 17 on the effects of ionizing radiation, including disinfestation, 21 on rearing techniques, 8 on radiation sterilization theory and application, and 28 on chemosterilants.

1761 Klement, A. W., Jr., Schultz, V. TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A Selected Bibliography - Supplement 3. TID-3910 (Suppl. 3), Division of Biology and Medicine (AEC), Washington D. C. Feb. 1965, 115p.

References are (title-)listed alphabetically, by senior author. No author or subject indexes.

1762 Klement, A. W., Jr., Schultz, V. TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A Selected Bibliography - Supplement 4. TID-3910 (Suppl. 4), Division of Biology and Medicine (AEC), Washington D. C. Apr. 1966, 128p.

References are (title-) listed alphabetically, by senior author. No author or subject indexes.

1763 Rossouw, S. F., comp. RADIOISOTOPES AND RADIATION IN HELMINTHOLOGY. A Bibliography. PEL-130, Atomic Energy Board, Pelindaba, Pretoria (South Africa). Oct. 1966, 29p.

87 references, often with abstracts, are presented to literature published between 1948 and 1966 on the use of radiation and radioisotopes in the control of helminthic diseases in man and animals. Several references are relevant also in the overall context of the present bibliography.

1764 Ward, H. L., comp. RADIOISOTOPES IN THE BIOLOGICAL SCIENCES. TID-3585, Division of Technical Information Extension (AEC), Oak Ridge, Tenn. Apr. 1967, 120p.

A collection of 959 references, largely with abstracts, has been assembled for the period 1958-1964, dealing with broad fields such as general studies in biology, cell physiology, ecology, entomology, genetics, immunology, microbiology, nutrition, and plant physiology. An author index, report number and availability index, and an isotope index are included. No subject index.

See also:

571 Radioactive nuclides and pesticide chemistry. III. (Dedek, W., 1967)

3.2.2. Surveys

1765 Andreev, S. V., Martens, B. K. AU LABORATOIRE DE BIOPHYSIQUE. Zashch. Rast. No.11 (1967) 25-27. (In Russian, with French summary)

Insectes, matériel végétal, micro-organismes; γ, isotopes radioactifs, méthodologie nucléaire; éradication insectes, sélection microorganismes utiles, métabolisme et toxicité pesticides, défense culture. - Programme recherche Institut supérieur protection végétale URSS. (BB 6; 1968, 5378)

1766 Bhambahani, G. RADIATION AND RADIOISOTOPES. Rajasthan Vet. 1, 3 (1966) 9-13.

Brief survey of applications in pest control. *

* Original not available.

1767 Boczek, J. ZASTOSOVANIE IZOTOPOW W BADANIACH ENTOMOLOGICZNYCH. (Radioisotopes in Entomological Research). Ogrodn. 2 (1965) 245-247. (In Polish)

1768 Burden, G. S. COCKROACH CONTROL, PAST PRESENT FUTURE. Pest Control 35, 9 (1967) 20, 22, 24, 28.

The potential uses of γ-radiation and biocontrol measures are discussed in addition to the more conventional methods in use at present.

1769 Cadahia, D. LAS RADIACIONES IONIZANTES EN LA ENTOMOLOGIA APLICADA. (Ionizing radiations in applied entomology.) Boln Serv. Plagas for. 8, 15 (1965) 15-27. (In Spanish)

General review. Sterilizing and lethal effects of radiations are discussed, and the data collected in two tables.

1770 Cadahia, D. IONIZING RADIATION IN APPLIED ENTOMOLOGY. Montes 22 (1966) 159-168. (In Spanish)

A review is given of the present state of experimentation and application of radioisotopes in entomology. Studies on genetics, sterilisation, and lethal effects of radiation are included. The practical uses of radiation in the control of insects are summarized under four headings: release of sterile males, development and release of insect races with inferior or lethal genetic characteristics, irradiation of products affected by insects, and irradiation of plants for the production of useful mutations. (NSA 22: 1968, 10881)

1771 Carleton, W.M. et al. PEST CONTROL BY PHYSICAL MEANS. Paper presented at the AAAS Meeting, Washington, D.C., USA. 26-31 Dec. 1966". n.p.

Techniques using radiation, sound, electrostatic charges, or other physical methods are described; hazards due to chemical and biological agents are minimized.

1772 Cavalloro, R. UTILIZZAZIONE DELLE RADIOAZIONI IONIZZANTI NELLA LOTTA CONTRO INSETTI AGRARIAMENTE DANNOSI. (The use of ionizing radiations in the fight against harmful agricultural insects.) Boll. Ist. Ent. agr. Oss. Fitopath. Palermo 7, 56 (1967) 101-112. (In Italian)

Survey article.

1773 Gerrard, M. RADIOISOTOPE PROGRAM OF THE INTERNATIONAL ATOMIC ENERGY AGENCY. Isotopes Radiat. Technol. 4 (1967) 430-431.

The International Atomic Energy Agency uses large radioisotope sources as well as tracers in its work. Among the programmes currently being sponsored by the IAEA is the use of radioisotope sources for disinfestation of grain and processing of other foods, sterilisation of pharmaceuticals and medical supplies, remote therapy of cancer, and insect control by the sterile-male-release technique. Tracer studies include those in hydrology, fertilizer utilisation, and nutrition. (Auth.)

1774 Hoffman, C.H. et al. THE FIGHT AGAINST INSECTS. Yb. Agric. U.S. Dep. Agric. (1966) 25-38.

Review of control techniques: chemical, sterilisation, biocontrol and integrated measures.

1775 Jenkins, D.W. RADIOISOTOPES IN ECOLOGICAL AND BIOLOGICAL STUDIES OF AGRICULTURAL INSECTS. AD-636895, Army Biological Labs., Frederick, Md. 1960, 19p.

For abstract, see II/4.

1776 Kloft, W. ÜBER DIE VERWENDUNG VON RADIOAKTIVEN ISOTOPEN IN DER MODERNEN BIOLOGIE. (On the application of radioactive isotopes in modern biology.) Prax. Biol. 6 (1957) 125-130.

The survey also considers the use of radioisotopes in entomology.

1777 Labrador, J.R. APPLICACION DE LOS RADIOISOTOPOS EN ENTOMOLOGIE. (Application of radioisotopes in entomology.) Ingenieria agron. 11 (1963) 19-25. (In Spanish)

1778 Marais, P.G. THE USE OF RADIOISOTOPES AND IONIZING RADIATION IN AGRICULTURAL RESEARCH. S. Afr. J. Sci. 59 (1963) 319-324. (In Afrikaans)

Applications of radioisotopes in agriculture and food research are described. In South Africa, the greatest interest was shown in the possibility of preserving fruit by γ-irradiation. For this purpose, a 500-Ci ^{60}Co irradiation centre was installed. With this high intensity radiation, male insects are sterilised so that insect pests can be eventually eradicated.

1779 Mia, M.M. ATOMIC ENERGY FOR AGRICULTURE. Nucleus, Lahore 2, 1 (1965) 30-34.

The importance of using in agricultural fields the latest research tools - radioisotopes and radiation sources - in Pakistan is discussed. A brief survey is presented of the activities of the Agricultural Research Centre, Dacca in plant genetics, plant physiology, soil chemistry, and entomology. The IAEA-PAEC coordinated programme is also briefly discussed. (NSA 19: 1965, 33726)

1780 Montgareuil, P. G., de LES RECHERCHES FRANCAISES EN AGRONOMIE NUCLEAIRE. CEA-R-2524, Commissariat à l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucléaires. Jul. 1964, 12p.

Work in the field of nuclear agronomy carried out in France since 1958 is reviewed. Topics discussed include applications of radiation in studies of plant genetics, pest eradication, food processing, measurements of soil humidity and density, and the use of radioisotopes as tracers in studies of plant physiology, agronomy, pathology, agricultural entomology, and metabolism in domestic animals. (NSA 19: 1964, 8720)

1781 Nagy, B., Pozsár, B., Szalay-Marzsó, L. "Sugárzások alkalmazása állati kártevők elleni védekezésben". (The use of ionizing radiations for the control of harmful animals.) Budapest, Országos Atomenergia Bizottság. Izotóp Intézet. 1965, 83p. (In Hungarian)

This monograph was compiled on behalf of the Institute of Isotopes of the Hungarian Atomic Energy Commission, the authors being scientists of the Hungarian Research Institute for Plant Protection. After indicating the expected advantages of using radiations in integrated pest control, some fundamental concepts are outlined. The biochemical effects of irradiation at the cellular level, on animal behaviour, populations, and the relation between the effects of radiations and some abiotical factors are treated in separate sections. Pest control techniques employing radiations, and other potential applications against insects are discussed. In an appendix the effects of radiations on the chemical composition of food-stuffs, radiation protective substances and their application, and radiation facilities and radiation health requirements in radioentomology are treated in individual sections. Proposals are made for the use of ionizing radiations in pest control in Hungary. 251 references are cited.

1782 Nagy, B. POSSIBILITIES OF USING IONIZING RADIATION IN THE CONTROL OF INSECTS IN HUNGARY. Atomtech. Tajek. 10 (1967) 1-6. (In Hungarian)

The uses of ionizing radiation and radioisotopes in entomology are reviewed. Radioisotope application to the study of food dispersion, hibernation, and migration of insects is considered. Techniques for eradication of insects by irradiation are compared, and the application of sublethal doses in the sterile male flooding method for control of May cockchafers in Hungary is discussed. (tr-auth)

1783 Nelson, S.O. NEW WAYS TO CONTROL INSECTS. Farm Ranch Home Q. No. 132 (1968) 15-16.

Survey article. The use of electromagnetic, sonic, and ultrasonic energy to control insect pests is discussed. γ- and x-radiation have already been used in applications of the sterile-male technique, the examples quoted being the screw-worm and the melon fly. Insect light traps were used to control the tobacco hornworm populations. Grain beetles were killed by γ-rays, radio frequency electric fields or infrared radiation without damaging effects to the nutritional qualities of the grain. The possibility of using sound and ultrasound for insect control through influencing behaviour is suggested.

1784 Nelson, S.O. ELECTROMAGNETIC ENERGY. Pest Control Biol., Phys. Sel. Chem. Methods (1967) 89-145.

Radio, u.v., visible, infrared, ionizing radiation effects on insects, products and applications.

1785 Price, C.E. FRUIT FLY MUTANT DATA STORAGE AND RETRIEVAL SYSTEM. K-DP-1711, Oak Ridge Gaseous Diffusion Plant, Tenn. 8 Aug. 1966, 27p.

A computer-based system is described that maintains a master data file on Drosophila melanogaster mutants and that can provide output lists in various arrangements. More than 9000 mutants are on file. Flow charts are given, and the programme phases are described in detail. The programmes are written in the COBOL language with some MAP routines for the IBM 7090/7094 and 1401 computers. (NSA 21: 1967, 39377)

1786 Price-Jones, D. NEW HORIZONS IN INSECT CONTROL. Chem. Inds. Lond. No. 19 (1967) 770-774.

Some of the newer methods for insect control are discussed. These include microbial insecticides, integrated control, behaviour determinants, biological control, and sterility and genetic manipu-

lation. For example, Bacillus thuringiensis can be produced commonly by culturing on axenia media and is pathogenic to a wide range of caterpillars and to only a few other insects. Integrated control is synonymous with ecological or bio-environmental control. Methyl eugenol is a behaviour determinant which has been employed to control fruit flies. The use of parasites and predators and the development of insect pathogens are examples of biological control of insects. γ-Irradiation from ^{60}Co sterilizes the screw-worm pupae and other insects. (CA 67: 1967, 20959f)

1787 *Robredo, F. USE OF RADIOACTIVE ISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY. Boln Serv. Plagas for. 7, 13 (1964) 42-51. (In Spanish)

Use of radiation in controlling insect pests is surveyed. A brief review on the methods of labelling insects with radioisotopes is given, as well as examples showing how radioisotopes have been of value in studying the dispersal and movement, life history, and behaviour of insects. Ecological studies on food chains, nutrition cycles, and population dynamics have been carried out on radioisotope-tagged insects. Application of the first method, exemplified by work on Callitroga hominivorax, is limited to very few species by several biological requirements. Direct treatment could have wider application for the control of all species infesting stored food products. The most favourable products for radiation disinfestation are those handled in bulk such as grain. Some fundamental and applied problems in using radiation for this purpose are discussed and the relative merits of chemical fumigation and irradiation methods are compared. Radiation induces dominant lethal mutations in sperm; therefore, monogamy is not requisite for eradicating a population through the introduction of irradiated males. Possible effects on populations of release of males containing recessive lethal mutations are discussed, and the possibility of genetic induction of population extinction is explored. (NSA 21: 1967, 32770)

* Originally cited without abstract, as III/1073.

1788 Suess, A. USE OF RADIOISOTOPES AND IONIZING RADIATION IN AGRICULTURAL SCIENCE. p. 351-357 of "Atomstrahlung in Medizin und Technik". Munich, Federal Republic of Germany, Verlag Karl Thiemig KG. 1964. (In German)

The studies made at the Bayr. Landesanstalt für Bodenkultur, Pflanzenbau, und Pflanzenschutz on the use of radioisotopes and radiation in agricultural science are reviewed. Among the studies discussed are the spread of insect pests, early detection of virus infection, tracing growth patterns, germination, production of mutations, and uptake of nutrients. Examples of the results obtained are given to indicate the type of information that can be obtained with the use of radioisotopes and radiation. (NSA 18: 1964, 35912)

1789 Watters, F. L. PHYSICAL METHODS OF INSECT CONTROL. Proc. ent. Soc. Manitoba 21 (1965) 18-27.

This paper reviews the major physical agents presently being used or studied as methods of insect control. Included in the discussion are: electromagnetic radiation, ionizing radiation, temperature, sound, mechanical force, air movement, atmospheric ions, insect-proof containers, and sanitation. The possibility of integrating these methods with chemical control is discussed and the use of radiation in programmes of sterile-male release is explained. (BA)

1790 Zeleny, V. INTERNATIONAL EXPERIENCE IN THE USE OF RADIOISOTOPES. CONF-9-21, International Atomic Energy Agency, Vienna (Austria). "International Conference on Future Development of Power Reactors and on Radioisotopes. Montreal, Canada. May 1963, 12p.

Applications of radioisotopes in agriculture, medicine, and industry on an international basis are discussed. Programmes described include: isotope techniques in rice cultivation, the use of radiation for control of harmful insect populations, and radiation disinfestation of grain.

See also:

40 Some biochemical aspects of insect metamorphosis. (Gilbert, L. I. et al., 1961)
564 Radioisotopes in entomological studies of endemic and tropical diseases. (Jenkins, D. W. 1960)
565 Radioisotopes in entomology and tropical medicine. (Jenkins, D. W., 1961)
1283 Institut national de génétique du Japon. (Tokin, B. P., 1967)
1551 Research activities of the association EURATOM-ITALY. (Zeeuw, D. de., 1966)

3.2.3. Training Courses

1791 International Atomic Energy Agency, Vienna (Austria) and Food and Agriculture Organization of the United Nations, Rome (Italy). "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology, Gainesville, Fla., 4 Oct. - 26 Nov. 1965". Gainesville, University of Florida. 1965, 171p.

A list of participants and lecturers is given. Abstracts of the lectures are included. Part I of the lectures gave a background to the whole course: the fundamentals of tracer methodology in theory and practice (C.H. Schmidt); counting statistics, and laboratory work on autoradiography (D.S. Anthony); fundamentals of radiobiology, and medical applications of isotopes and radiation (H. L. Cromroy); fly eradication projects (J. C. Keller); neutron activation analysis (R.G. Cockrell); and on the use of various types of instruments available commercially. Part II dealt with the use of radioisotopes for the study of systemic insecticides in plants (D. L. Bull); metabolism of chlorinated hydrocarbon insecticides by insects (A. S. Perry); use of tritiated water for continuous registration of insect transpiration; use of radioisotopes in research on social insects; principles of internal and external tagging of insects under special consideration of physiological and ecological aspects; use of radioisotopes with plant sucking insects; some aspects on phytopathology (all four by W.J. Kloft); use of radioisotopes in dispersion studies: part A--Flies, part B--mosquitoes and cockroaches (H. F. Schoof); eradication of the screw-worm fly from Southern United States (A.H. Baumhover); laboratory and field studies of ticks labelled with radioisotopes (B.J. Smittle); chemosterilants as a potential weapon for insect control (C.N. Smith); application of chemosterilants (G.C. LaBreque); cytological effects of chemosterilants on house fly ovaries (P.B. Morgan); use of gamma radiation and sterilization techniques for control of fruit and vegetable insect pests (A.K. Burdett, Jr.); dispersion studies of Culex pipiens fatigans Wied. tagged with ^{32}P in the Kemmendine Area of Rangoon, Burma (from WHO/Vector Control/157.65); sterile male release studies with Drosophila melanogaster Meigen (T.J. Henneberry); fundamental principles of radiation-induced insect sterility (L.E. LaChance); the effects of γ-radiation on the soil (C.F. Eno); projecting laboratory rearing of insects to mass-scale factory-type project (C.N. Husman). Laboratory exercises were divided into metabolism of ^{14}C malathion in the house fly (F.W. Plapp, Jr.); the use of radioisotopes for the study of systemic insecticides in plants (D.L. Bull); laboratory exercises for studying the metabolic fate of insecticides by use of isotope-labelled compounds (A.S. Perry); laboratory exercises on insect sterilization (LaBrecque, G.C., Morgan, P.B., Glancey, B.M., Meifert, D.W.); tracer experiments on uptake and social distribution of food in ants; two more or less extended tracer experiments with ants; tagging of mosquitoes as larvae; biological half-life in cockroaches using ^{32}P and ^{131}I separately; tagging adult house flies for estimation of population density by "isotope dilution" method; topical application of ^{32}P as phosphate in water solution on the pronotum of German cockroaches; determination of the speed of haemolymph circulation in insects by injected tracers; artificial feeding of bloodsucking insects; tracer experiments with aphids (all by W.J. Kloft).

1792 International Atomic Energy Agency, Vienna (Austria). LABORATORY TRAINING MANUAL ON THE USE OF ISOTOPES AND RADIATION IN ENTOMOLOGY. Technical Reports Series No. 61. Vienna, International Atomic Energy Agency. 1966, 144p.

The Food and Agriculture Organization of the United Nations and the International Atomic Energy Agency, in cooperation with the United States Department of Agriculture and the Department of the University of Florida, Gainesville, Fla., USA, have jointly sponsored two international training courses on the use of isotopes and radiation in entomology. Scientific authorities from several countries have contributed lectures and, together with the IAEA Secretariat, devised laboratory exercises embracing many and varied entomological techniques. The present manual consists of two parts: a basic part containing general information and laboratory exercises on the properties of radiation and the principles of use of radioactive tracers, and an applied part consisting of detailed laboratory exercises in the use of isotopes and radiation in entomology. (From the foreword)

1793 International Atomic Energy Agency, Vienna (Austria) and Food and Agricultural Organization of the United Nations, Rome (Italy). "Proceedings of FAO/IAEA Training Course on Use of Radioisotopes in Entomology. Gainesville, Fla., USA, 2 Oct. - 24 Nov. 1967". Gainesville, Fla., University of Florida. 51p.

The training course was held at the University of Florida, Gainesville from Oct. 2 - Nov. 24, 1967. Similar training courses had been held at the University of Florida in 1963 and 1965. Objectives of the course were to teach and train entomologists in the theories and nature of radiation, radioisotope methodology, and the applications of radioisotopes to research in entomology. The course was divided into lectures given by invited specialists in the field. The proceedings give a list of the lecturers, abstracts of the lectures, and the laboratory exercises. These were primarily those in the IAEA "Laboratory Manual on The Use of Isotopes and Radiation in Entomology" (see 1792). 16 countries were represented.

4. TABLES

TABLE 1. SYSTEMATIC LISTING OF INSECTS AND RELATED ARTHROPODS

Class	Order	Family	Systematic Code	Scientific Name
ARACHNIDA	Araneida		Ar	
		Agelenidae	Ar. 1	
				Agelena consociata (Denis)
				Tegeneria derhamii
		Avidulariidae	Ar. 1/2	Avicularia avicularia
		Gnaphosidae	Ar. 2/3	gnaphosids
		Lycosidae	Ar. 4	
				Lycosa punctulata (Hentc)
	Acarina		Ac	
		Acaridae	Ac. 1	
				Acarus siro Linnaeus
				Tyrophagus dimidiatus (Hermann)
				Tyrophagus longior (Gerv.)*
		Argasidae	Ac. 2	
				Ornithodoros papillipes (Bir.)
				Ornithodoros tholozani (Lab. & Mégn.)
		Arrenuidae	Ac. 2/3	
				Arrenurus papillator (O. F. Müll)
		Gamasidae	Ac. 7/8	
				Ornithonyssus (Liponyssus) bacoti (Hirst)
		Ixodidae	Ac. 8	
				Amblyomma americanum (Linnaeus)
				Boophilus microplus (Canestrini)
				Dermacentor andersoni (Stiles)
				Dermacentor occidentalis Marx
				Dermacentor variabilis (Say)

* see Tyrophagus dimidiatus (Hermann)

Common Name(s)	Reference No.
spiders	507, 525-6, 556
funnel-web weavers	
	481
	230
	408
	73
wolf-spiders	73, 543
	73
mites and ticks	514
acarid mites	
grain mite	1339, 1468, 1677
	1352, 1435-7, 1535
	1436
soft-backed ticks	
	17, 1387
	1387, 1622
	432
	1313
hard-backed ticks	
Cayenne tick; lone star tick	503, 568, 1297, 1791
Southern cattle tick	569, 614, 676, 780, 782, 1267
Rocky Mountain wood tick	568
Pacific Coast tick	1397
American dog tick	568

Class	Order	Family	Systematic Code	Scientific Name
ARACHNIDA	Acarina	Tetranychidae	Ac. 14	
				Panonychus ulmi (Koch)
				Tetranychus telarius (Linnaeus)
				Tetranychus urticae (Koch)
INSECTA	Thysanura		B	
		Lepismatidae	B. 1	
				Lepisma saccharina Linnaeus
	Ephemeroptera		E	
		Heptageniidae	E. 6	
				Heptagenia hebe (McDunnough)
				Stenonema fuscum (Clemens)
				Stenonema interpunctatum (Say)
	Odonata		F	
		Aeshnidae	F. 1	
				Aeschna cyanea (Müll.)
				Aeschna grandis (Linnaeus)
				Aeschna viridis Eversm.
				Anax imperator (Leach)
				Boyeria irene (Fonscolombe)
		Agrionidae	F. 2	
				Platycnemis pennipes
		Calopterygidae	F. 2/3	
				Calopteryx splendens
		Coenagrionidae	F. 3	
				Argia translata

Common Name(s)	Reference No.
spider mites	1128
European red mite	APX. 9
two-spotted spider mite	799
two-spotted spider mite	213, 487, APX. 9
bristletails	
firebrats, silverfish	
silverfish	1463
mayflies	
	631
	631
	631
damselflies and dragonflies	433-4, 531
	435
a dragonfly	62, 435
	435
	435
	435
a dragonfly	432
a dragonfly	432
	1394

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Odonata	Cordulegastridae	F. 4	
				Cordulegaster boltonii (Donovan)
		Lestidae	F. 7	
				Lestes sponsa Hans.
		Libellulidae	F. 8	
				Libellula depressa
				Libellula quadrimaculatus
				Somatochlora flavomaculata
				Sympetrum danae
				Sympetrum depressiusculum (Sel.)
				Sympetrum vulgatum
	Plecoptera		G	
	Orthoptera		H	
		Acrididae	H. 1	
				Chorthippus elegans
				Chorthippus longicornis
				Chorthippus parallelus
				Chortophaga
				Chortophaga viridifasciata (De Geer)
				Chrotogonus incertus Bolivar
				Encoptopholus sordidus (Burmeister)
				Gomphocerus maculatus
				Locusta migratoria Linnaeus
				Mecostethus grossus

Common Name(s)	Reference No.
	435
	432
	435
	432
	432
	432
	510
	432
stoneflies	524
cockroaches, grasshoppers and allies	51, 525
grasshoppers	1, 54, 185, 307, 614, 929, 936, 952, 996-7, 1886, 1534
	973
	1088
	973
	275
green-striped grasshopper	252, 274, 308, 1016-7
	1032
	1017
	973
migratory locust	137, 152, 194, 199, 251, 301-2, 362, 385, 403-4, 417, 536
	973

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Orthoptera	Acrididae	H. 1	
				Melanoplus biliteratus
				Melanoplus bivittatus (Say)
				Melanoplus differentialis (Thomas)
				Melanoplus femurrubrum (De Geer)
				Oedipoda coerulescens Linnaeus
				Omocestus viridulus
				Podisma sapporense
				Schistocerca gregaria Forsk
		Blaberidae	H. 1/2	
				Blabera fusca Br.
		Blattidae	H. 2	
				Blaberus sp.
				Blaberus craniifer Burmeister
				Blaberus discoidalis
				Blaberus giganteus
				Blattella germanica (Linnaeus)
				Leucophaea maderae (Fabricius)
				Eurycotis floridana
				Nauphoeta cinerea
				Periplaneta americana (Linnaeus)
				Periplaneta australasiae (Fabricius)
		Conocephalidae	H. 2/3	
				Homorocoryphus

Common Name(s)	Reference No.
grasshoppers	
	556
two-striped grasshopper	87
differential grasshopper	197
red-legged grasshopper	547, 556
	53
	973
	1020
desert locust	47, 139, 158, 177, 362, 385, 558, 599, 600, 938, 981, 1001-3, 1347, 1441
	1328, 1329
cockroaches	766, 1324, 1788
	362
Florida tropical cockroach	1326
	95
	821
German cockroach	175, 189, 359, 387, 393-4, 637-8, 657, 848, 1100, 1791
Madeira cockroach	105-7, 235, 374, 401, 446
	364, 382-3
	1125
American cockroach	61, 70, 84-5, 87, 103, 168, 175, 207, 229, 349, 362, 372, 381, 383, 387, 401, 412-3, 420, 429, 537, 622-3, 638, 658-9, 690, 700, 767, 788, 848, 1193, 1739, 1791, APX. 8
Australian cockroach	362
grasshoppers	51, 53, 55

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Orthoptera	Conocephalidae	H. 2/3	Homorocoryphus nitidulus Scop.
		Gryllidae	H. 4	
				Acheta domesticus (Linnaeus)
				Gryllus bimaculatus (De Geer)
				Gryllus campestris Linnaeus
				Gryllus domesticus Linnaeus
				Gryllus firmus
				Oecanthus celerinictus
		Gryllotalpidae	H. 5	
				Gryllotalpa gryllotalpa Linnaeus
		Mantidae	H. 6	
				Mantis religiosa (Linnaeus)
				Tenodera aridifolia sinensis (Saussure)
		Phasmatidae	H. 7	
				Anisomorpha buprestoides
				Carausius morosus Br.
		Tettigoniidae	H. 9	
				Ephippiger ephippiger Fieb.
				Orchelimum fidicinum
				Tettigonia viridissima
	Dermaptera		I	
		Labiidae	L 3	
				Chelisoches morio
	Isoptera		K	
		Kalotermitidae	K. 2	
				Cryptotermes brevis (Walker)
				Kalotermes flavicollis (Grassé & Noirot)

Common Name(s)	Reference No.
	53, 55
crickets	54, 507
brown cricket; European brown cricket; house cricket	281, 283, 431, 515-6, 538, 543
	186, 265, 456
	53
domestic cricket	418, 966
field cricket	556
tree cricket	556
mole crickets	54
	53
praying mantis	
European praying mantis	199, 547
Chinese mantis	543
walkingsticks	
stick insect	388
stick insect	85, 390, 409
longhorn grasshoppers and katydids	54
	53
	526
	1463
earwigs	
an earwig	1327
termites	
	494
drywood termite	469, 488, 979

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Isoptera	Rhinotermitidae	K. 3	
				Reticulitermes flavipes (Kollar)
		Termitidae	K. 4	
				Microcerotermes edentatus Wasmann
	Hemiptera			
	(Heteroptera)		Q	
		Belostomatidae	Q. 3	
				Hydrocyrius columbiae
				Lethocerus cordofanus
		Cimicidae	Q. 5	
				Cimex lectularius Linnaeus
		Coreidae	Q. 6	
				Harmostes reflexulus
		Corixidae	Q. 7	
				Corixa geofroy
				Corixa punctata Ill.
				Micronecta minutissima
		Geocoridiae	Q. 8/9	
				Ischnodemus badius
				Trigonotylus sp.
		Gerridae	Q. 9	
				Gerris buenoi (Kirk.)
				Gerris locustris (Linnaeus)
		Lygaeidae	Q. 10	
				Elasmolomus sordidus (Fabricius)
				Nysius raphanus

Common Name(s)	Reference No.
Eastern subterranean termite	1715, 1721
	1743
	525
true bugs	1522
giant water bugs	
	56
	56
bat, bed, and bird bugs	1728
bed bug	801
coreid bugs	
grass bug	556
water boatmen	
	531
	1728
	531
	526
	526
water striders	
	545
	1728
lygaeid bugs	
peanut litter bug	192-3
	556
milkweed bugs	507

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Hemiptera (Heteroptera)	Lygaeidae	Q.10	Oncopeltus fasciatus (Dallas)
		Miridae	Q.11	
				Lygus oblineatus
		Nepidae	Q.13	
				Ranatra linearis Linnaeus
		Notonectidae	Q.14	
				Notonecta glauca Linnaeus
		Pentatomidae	Q.15	
				Eumecopus punctiventris (Stål)
				Perillus bioculatus (Fabricius)
		Pyrrhocoridae	Q.17	
				Dysdercus peruvianus
				Pyrrhocoris apterus Linnaeus
		Reduviidae	Q.18	
				Rhinocoris iracundus Pd.
				Rhodnius prolixus (Stål)
				Triatoma infestans
	Hemiptera (Homoptera)		QQ.	
		Aleyrodidae	QQ.1	
				Chrysomphalus aonidum (Linnaeus)
				Trialeurodes vaporariorum (Westwood)
		Aphididae	QQ.2	
				Aphidina ovipara
				Aphis fabae (Scopoli)
				Chaetophoria xanthomelas (Koch)
				Cinara larvicola

Common Name(s)	Reference No.
large milkweed bug	87, 149, 157, 282, 430, 454, 610, 690, 797, 1728
plant bugs	
	560
waterscorpions	
	510
backswimmers	
	510, 1728
stink bugs	
	192-3
two-spotted stink bug; Canadian bug	489
pyrrhocorid bugs	
Peruvian cotton stainer	1290
	1728
assassin bugs	
	1728
	497
	104, 110, 112, 163, 562, 625
aphids, leafhoppers, planthoppers, scale insects, and allies	525
whiteflies	
Florida red scale	13
greenhouse whitefly	802, APX. 9
aphids	452
	1463
bean aphid	454, 473-4, 478, 482, 622
	549
	480

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Hemiptera (Homoptera)	Aphididae	QQ. 2	Macrosiphum pelargonii (Kaltenbach)
				Macrosiphum pisi
				Megoura viciae (Buckt.)
				Myzocallis discolor
				Myzodes persicae (Sulzer)
				Myzus ascalonicus
				Myzus persicae Sulz.
				Tuberolachnus salignus
		Cercopidae	QQ. 4	
				Clastoptera xanthocephala Germar
		Cicadellidae	QQ. 6	
				Aceratagallia sanguinolenta (Provancher)
				Calligypona pellucida (Fabricius)
				Carneocephala flaviceps (Riley)
				Cuerna costalis
				Empoasca sp.
				Javesella pellucida (Fabricius)
				Scaphytopius acutus
		Coccidae	QQ. 8	
				Coccus hesperidum Linnaeus
		Delphacidae	QQ. 10	
				Perkinsiella saccharicida Kirkaldy
		Fulgoridae	QQ. 13	
				Delphacodes sp.
				Pissonotus delicatus

Common Name(s)	Reference No.
	802
pea aphid	799
	322, 476, 940
	1530
	470-1
	560, 1791
green peach aphid	19, 175, 475, 486, 560, 1791
willow aphid	84
spittlebugs	
sunflower spittle bug	556
leafhoppers	739
clover leafhopper	556
leafhopper	504
yellow-headed leafhopper	556
leafhopper	556
leafhopper	556
leafhopper	18, 498
leafhopper	556
soft scales	
brown soft scale	1306
delphacid planthoppers	
sugar cane leafhopper	1144, 1149, 1573
fulgorid planthoppers	
planthopper	556
	556

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Hemiptera (Homoptera)	Fulgoridae	QQ. 13	Prokelisia marginata
		Jassidae	QQ. 14/15	
				Macrosteles fascifrons
				Orosius argentatus
		Pseudococcidae	QQ. 18	
				Planococcus citri (Risso)
				Pseudococcus gahani Green
				Pseudococcus njalensis (Laing)
				Pseudococcus obscurus Essig
		Psyllidae	QQ. 19	
				Psylla pyricola Foerster
	Neuroptera (Planipennia)		RRR.	
		Chrysopidae	RRR. 1	
				Chrysopa perla
	Mecoptera		S.	
		Panorpidae	S. 3	
				Panorpa communis
	Trichoptera		T.	
				Brachycentrus

Common Name(s)	Reference No.
	526
	560
	560
mealybugs	
citrus mealybug	802, 1402
	1402
mealybug	59
	1402
jumping plantlice or psyllids	
pear psylla	108, APX. 9
green lacewings	
	280
scorpionflies	
scorpionfly	154
caddisflies	496, 523-4, 529
caddisfly	523

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Trichoptera	Hydropsychidae	T. 1	
				Hydropsyche
	Lepidoptera		U.	
		Arctiidae	U. 2	
				Hyphantria cunea Drury
		Bombycidae	U. 3	
				Bombyx mori (Linnaeus)
		Cossidae	U. 7	
				Zeuzera aesculi
		Crambidae	U. 8	
				Chilo suppressalis (Walker)
				Diatraea saccharalis (Fabricius)
				Tryporyza incertulas
		Galleriidae	U. 12	
				Galleria mellonella (Linnaeus)
		Gelechiidae	U. 13	
				Pectinophora gossypiella (Saunders)
				Pectinophora malvella Herbst
				Sitotroga cerealella (Olivier)
		Hesperiidae	U. 19	
				Calpodes ethlius (Stoll)

Common Name(s)	Reference No.
caddisfly	523
butterflies, moths, skippers	51, 453, 556, 1133, 1317, 1677
tiger moths and allies	
fall webworm	57, 1338
silkworm moths	
silkworm	43, 195, 299, 300, 924, 928, 933, 954, 956-8, 964, 972, 974-5, 987, 1089, 1091, 1094, 1107-8, 1213, 1238, 1271, 1283, 1368-70, 1708, 1719
	81, 86, 93a, 98, 117, 122, 134, 148, 155, 178-9, 184, 196, 206, 211, 219, 220-2, 233, 236, 258-9, 260-1, 319, 329, 351-3, 377, 395, 397, 423-7, 437, 440, 725, 912, 923, 1061, 1093, 1199, 1279, 1287, 1305, 1356, 1363, 1399, 1400-1, 1450, 1536, 1709
carpenterworm moths	
	1132
grass moths	
Asiatic rice borer	724, 788, 1385, 1442, 1559
	1156, 1157-9, 1621, 1688
	1559
wax moths	
greater wax moth	330, 359, 390-1, 405-7, 1103, 1316, 1357
gelechiid moths	
pink bollworm	1559
hollyhock-seed moth; mallow moth	1123, 1392, 1618
Angumois grain moth	1342, 1376-7, 1396, 1705-6
skippers	
large canna leaf roller	140-1, 187, 419

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Lepidoptera	Lasiocampidae	U. 22	
				Dendrolimus pini
				Macrothylacia rubi Linnaeus
				Malacosoma
				Malacosoma americanum (Fabricius)
				Malacosoma neustria Linnaeus
		Leucopteridae	U. 22/23	
				Leucoptera coffeella Guer.
		Lymantriidae	U. 25	
				Lymantria dispar
				Lymantria monacha (Linnaeus)
				Ocneria dispar Linnaeus
				Porthetria dispar (Linnaeus)
		Noctuidae	U. 29	
				Agrotis orthogonia Morrison
				Agrotis segetum
				Barathra brassicae
				Heliothis armiger
				Heliothis virescens (Fabricius)
				Heliothis zea (Boddie)
				Laphygma frugiperda (J. E. Smith)
				Peridroma saucia (Hübner)
				Phytometra gamma Linnaeus
				Prodenia eridania (Cramer)
				Prodenia litura Fabricius
				Rhyacia* c-nigrum Linnaeus
				Scoliopteryx

* Amathes

Common Name(s)	Reference No.
tent caterpillar moths and allies	54
pine spinner	499
	53
	359
Eastern tent caterpillar	1443
	416
coffee leaf miner	1131, 1545
tussock moths	
gipsy moth	1146
nun moth	499
unmatched gipsy moth	1380
gipsy moth	878, 1559
owlet moths and underwings	52, 54, 1476
pale Western cutworm	175
a cutworm	1412
	314
	1577
tobacco budworm	685-7, 700, 702, 813-4, 1127, 1355, 1559
bollworm; corn earworm; tomato fruitworm	699, 700, 702, 799, 807, 814, 1559
fall armyworm	1309
variegated cutworm	462
	53
Southern armyworm	411
cotton leaf worm	732, 823, 847, 1148, 1239
	53
	484

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Lepidoptera	Noctuidae		Scotia segetum Schiff.
				Spodoptera frugiperda (J. E. Smith)
				Trichoplusia ni (Hübner)
				Trigonophora meticulosa Linnaeus
				Triphaena pronuba Linnaeus
		Oiethreutidae	U. 33	
				Carpocapsa pomonella (Linnaeus)
				Grapholitha molesta (Busck)
				Rhyacionia buoliana (Schiffermütter)
		Papilionidae	U. 34	
				Papilio machaon Linnaeus
		Phycitidae	U. 36	
				Anagasta
				Anagasta kuehniella (Zeller)
				Elasmopalpus lignosellus (Zeller)
				Ephestia
				Ephestia cautella
				Ephestia* kuehniella Zeller
				Paramyelois transitella (Walker)
		Pieridae	U. 37	
				Colias eurytheme Boisduval
				Pieris brassicae Linnaeus
		Psychidae	U. 39	
				Thyridopteryx ephemeraeformis (Haworth)
		Pyralidae	U. 41	
				Corcyra cephalonica

* see Anagasta

Common Name(s)	Reference No.
	53, 55
fall armyworm	879, 884
cabbage looper	889, 1142
	53
	53, 55
olethreutid moths	
codling moth	1145, 1307, 1555, 1559, 1569, 1590, 1605-8, 1620
oriental fruit moth; leaf roller moth	30, 1302, 1559, 1740
European pine shoot moth	1281, 1332
swallowtail butterflies	54
	53
	1298
Mediterranean flour moth	1344
lesser cornstalk borer	1277
	29, 248-9
	1668
Mediterranean flour moth	1336, 1362, 1367, 1436, 1684
navel orangeworm	1153, 1569
white and sulphur butterflies	54
alfalfa caterpillar	234
white cabbage butterfly	53, 218, 223, 224, 303, 442, 467, 539, 540, 541, 993
bagworm moths	
evergreen bagworm	79, 532
pyralid moths	
rice moth	392

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Lepidoptera	Pyralidae	U. 41	Plodia interpunctella (Hübner)
		Pyraustidae	U. 42	
				Ostrinia nubilalis (Hübner)
		Saturniidae	U. 43	
				Antheraea eucalypti Scott
				Antheraea pernyi
				Antheraea polyphemus (Cramer)
				Eudia pavonica Linnaeus
				Hyalophora cecropia (Linnaeus)
				Philosamia cynthia
				Philosamia cynthia ricini (Donovan)
				Samia cynthia pryori (Drury)
		Sphingidae	U. 46	
				Celerio euphorbia
				Manduca sexta (Johannson)
				Protoparce sexta (Johannson)
				Sphinx ligustri
		Tischeriidae	U. 48	
				Thaumetopoeidae
				Thaumetopoea pithyocampa Schiff.
		Tortricidae	U. 49	
				Argyrotaenia velutinana (Walker)
	Coleoptera		V.	
		Anobiidae	V. 1	
				Lasioderma sericorne (Fabricius)

Common Name(s)	Reference No.
Indian meal moth	1342
pyraustid moths	
European corn borer	903, 984, 1379, 1559
giant silkworm moths	54, 321
	90
oak silkworm; Japanese oak moth	121, 206
polyphemus moth	244
	53
cecropia (silk) moth	64, 65, 66, 95, 100, 101, 105, 191, 225, 243-4, 269, 332, 346, 355, 356, 375, 401, 402, 453
	363, 993
	348
cynthia moth	99, 128, 243-4, 295-6, 346
sphinx moths	
hawk moth	202, 1305
tobacco hornworm	399, 400, 1553, 1559
	1565
	120
	52
pine processionary	53, 55, 905
leaf roller moths	
red-banded leaf roller	212
beetles	51, 593, 596, 1677
deathwatch and drugstore beetles	
cigarette beetle	1391, 1445, 1703

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Coleoptera	Bostrichidae	V. 5	
				Rhyzopertha dominica (Fabricius)
		Bruchidae	V. 7	
				Acanthoscelides obtectus (Say)
				Bruchus sp.
				Bruchus obtectus
				Callosobruchus chinensis Linnaeus
		Buprestidae	V. 8	
				Melanophila californica Van Dyke
		Carabidae	V. 11	
				Bembidion frontale
				Bembidion muscicola
				Carabus granulatus Linnaeus
				Carabus canellatus Ill.
				Pterostichus (Feronia) niger Schall
				Selenophorus ellipticus
				Selenophorus palliatus
				Triplectrus rusticus
		Cerambycidae	V. 12	
				Hylotrupes bajulus Linnaeus
		Chrysomelidae	V. 13	
				Altica marvegans
				Chrysomela decemlineata Say
				Chrysomela knabi Brown
				Hispa
				Dicladispa (Hispa) armigera (Ol.)

Common Name(s)	Reference No.
false powder-post beetles	
lesser grain borer	1391, 1668
seed beetles	
bean weevil	1344, 1684
	1742
	1577
pea weevil	1444
flatheaded or metallic wood borers	
California flatheaded borer	1754
ground beetles	
	11
	11
	416
	416
	418
	556
	556
	556
long-horned beetles or roundheaded wood borers	
European house borer; old-house borer	1293, 1656
leaf beetles	
leaf beetle; flea beetle	556
	1340
willow leaf beetle	48, 548
	1117
	1291

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Coleoptera	Chrysomelidae	V.13	Leptinotarsa decemlineata (Say)
		Cleridae	V. 15	
				Necrobia
		Coccinellidae	V. 16	
				Chilocorus bipistulatus Linnaeus
				Coleomegilla maculata (De Geer)
				Epilachna varivestis Mulsant
		Curculionidae	V. 19	
				Anthonomus grandis Boheman
				Apion sp.
				Cylas formicarius elegantulus (Summers)
				Hypera postica (Gyllenhal)
				Sitophilus granarius (Calandra granaria) (Linnaeus)
				Sitophilus oryzae (Linnaeus)
				Sitophilus zeamais Motschulsky
				Stemochetus mangiferae (Fabricius)
		Dermestidae	V. 20	
				Attagenus piceus (Olivier)
				Dermestes
				Dermestes vulpines
				Trogoderma glabrum (Herbst)
				Trogoderma granarium Everts
				Trogoderma versicolor

Common Name(s)	Reference No.
Colorado (potato) beetle	5, 311, 535, 1337, 1577, 1753
checkered beetles	
- ham beetle	1627, 1649
lady beetles	
a lady beetle	13
	114
Mexican bean beetle	1258
snout beetles or weevils	
boll weevil	371, 414, 448, 700, 702, 806, 807, 813-15, 881-2, 1136-8, 1141, 1268, 1331, 1439, 1553, 1579
a snout beetle	556
sweetpotato weevil	1320
alfalfa weevil	1124
omnivorous leaf roller	1555
granary weevil	1247, 1344, 1433, 1454, 1684, 1742
rice weevil	709, 815, 1341, 1344, 1361, 1391, 1403, 1426-7, 1668, 1684, 1751
	1460-1
mango seed weevil	1650, 1696
dermestid beetles	
black carpet beetle	1390
	1627, 1649
hide beetle	175
	1390, 1477
khapra beetle	1462, 1656, 1668, 1742
	APX. 8

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Coleoptera	Dytiscidae	V. 21	
				Acilius sulcatus Linnaeus
				Asynarchus sp.
				Callicorixa audeni (Hung.)
				Copelatus
				Dytiscus sp.
				Dytiscus marginalis
				Ilybius discedens (Shp.)
		Elateridae	V. 22	
				Conoderus vespertinus (Fabricius)
				Ctenicera destructor
		Gyrinidae	V. 23	
				Gyrinus natator
		Hydrophilidae	V. 25	
				Hydrophilus piceus Linnaeus
		Lampyridae	V. 26	
		Mordellidae	V. 33	
				Mordellistena
		Nitidulidae	V. 35	
				Meligethes aeneus (Fabricius)
		Phalacridae	V. 39	
				Olibrus sp.
		Scarabaeidae	V. 41	
				Amphimallon majalis (Razoumowsky)
				Amphimallon solstitialis
				Melolontha melolontha Linnaeus

Common Name(s)	Reference No.
predaceous diving beetles	
	418
	545
	545
	529
	545
	245, 418, 510, 1463
	545
click beetles, wireworms	
tobacco wire worm; click beetle	556
prairie grain wireworm	175
whirligig beetles	
	1463
water scavenger beetles	
	510
fireflies	231
tumbling flower beetles	
flower beetle	556
sap beetles	
	498
shining fungus beetles	
flower beetle	556
scarabs	52
European chafer	1365, 1578
	56
	1582

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Coleoptera	Scarabaeidae	V.41	Melolontha vulgaris Fabricius
				Oryctes rhinoceros
				Xylotrupes dichotomus (Linnaeus)
		Scolytidae	V. 42	
				Dendroctonus brevicomis LeConte
				Ips confusus (LeConte)
		Silphidae	V. 43	
				Necrophorus sp.
		Staphylinidae	V. 44	
				Pelecyphorus sp.
		Tenebrionidae	V. 46	
				Alphitobius diaperinus (Panzer)
				Eleodes armata
				Eleodes hispilabris
				Eleodes longicollis
				Gnathocerus cornutus (Fabricius)
				Lathridius (Enicmus) minutus Linnaeus
				Tenebrio molitor (Linnaeus)
				Tribolium sp.
				Tribolium castaneum (Herbst)
				Tribolium confusum Jacquelin duVal

Common Name(s)	Reference No.
cockchafer	91, 1559, 1569, 1580-1
	1561
horn beetle	724-5
bark beetles	
western pine beetle	1736
California five-spined ips	1479
carrion beetles	54
carrion beetles	53
rove beetles	
darkling beetle	496
darkling beetles	
lesser mealworm	1436
	534
	509
Arizona desert beetle	190, 214
broad-horned flour beetle	1436
grain beetle	1783
salami pest	1436, 1698
yellow mealworm	144, 216, 288, 311, 455, 599, 600, 1418, 1436, 1463, 1747
flour beetles	67, 1161, 1172, 1286, 1389, 1411
red flour beetle	1056, 1163-4, 1299, 1300-1, 1345, 1350, 1410, 1428, 1430, 1451, 1455, 1487, 1538, 1668
confused flour beetle	129, 250, 1163-4, 1300-1, 1319, 1346, 1348-9, 1351-2, 1391, 1398, 1410, 1434-7, 1440, 1458, 1535, 1538, 1741, 1748

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Hymenoptera		W.	
		Apidae	W. 3	
				Apis mellifera (Linnaeus)
				Apis mellifica Linnaeus
				Bombus lucorum
				Bombus terrestris
		Argidae	W. 4	
				Arge pagana Panz.
		Braconidae	W. 5	
				Bracon hebetor
				Habrobracon, Habrobracon juglandis
				Habrobracon serinopae
				Microbracon hebetor (Say)
		Cephidae	W. 6	
				Cephus cinctus Norton
		Chalcididae	W. 7	
				Mormoniella vitripennis (Walker) (= Nasonia brevicornis)
		Diprionidae	W. 12	
				Diprion hercyniae (Hartig)
				Neodiprion pratti (Dyar, Rohwer)
		Formicidae	W. 14	
				Acanthomyops claviger (Rogers)
				Camponotus
				Camponotus herculeanus (Linnaeus)

Common Name(s)	Reference No.
ants, bees, sawflies, wasps, and allies	51
bumble, carpenter, honey and stingless bees	
honey bee	69, 188, 209, 410, 444, 508, 550, 551, 554, 1289, 1722-4
honey bee	146-7, 468, 492, 518-9, 1294, 1463
bumble bee	56
bumble bee	498
argid sawflies	54
	53
braconids	
	63, 1456
	918, 935, 941, 968-9, 982, 1121-2, 1150, 1182-3, 1216-7, 1274, 1304, 1417, 1457, 1488, 1496, 1511-2
	1409
	127
stem sawflies	
wheat stem sawfly	175
chalcids	
	1060, 1114-5, 1129, 1408
conifer sawflies	
European spruce sawfly	240
Virginia pine sawfly; jack-pine sawfly	175
ants	520, 556, 1466, 1791
smaller yellow ant	376
	479
carpenter ant	552

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Hymenoptera	Formicidae	W. 14	Camponotus ligniperda (Latr.)
				Crematogaster clara
				Crematogaster striatula Emery
				Dolichoderus quadripunctatus
				Dorymyrmex pyramicus (Roger)
				Formica
				Formica cineraea (Mayr)
				Formica integra
				Formica polyctenea (Forster)
				Formica rufa
				Lasius neoniger
				Myrmica l. fracticornis
				Pogonomyrmex californicus (Buckly)
				Solenopsis molesta (Say)
		Ichneumonidae	W. 16	
				Devorgilla
				Nemeritis canescens (Gravenhorst)
		Mutillidae	W. 18	
		Pamphiliidae	W. 19	
				Acantholyda nemoralis (Thoms.)
		Siricidae	W. 23	
				Sirex spp.
		Sphecidae	W. 24	
				Dahlbominus fuscipennis (Zetterstedt)
		Vespidae	W. 29	
				Vespa

Common Name(s)	Reference No.
carpenter ant	552
	526
	59
	1318
pyramid ant	517, 556
	479
	495
	1467
	415, 416, 472, 483-4, 491, 493
	1463
	490
	11
California harvester ant	1473
thief ant	490
ichneumons	
	1104
	1298
velvet ants	1523
web-spinning sawflies	
sawfly	135, 409
horntails	
wood wasps	1656
cicada killers, mud daubers, and sand wasps	
	1053-5
hornets, yellow jackets, and potter wasps	
	485

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Diptera		X.	
		Calliphoridae	X. 5	
				Calliphora sp.
				Calliphora erythrocephala (Meigen)
				Callitroga hominivorax (Coquerel)
				Cochliomiya hominivorax (Coquerel)
				Lucilia spp.
				Lucilia cuprina (Wied.)
				Lucilia sericata Meig.
				Phormia regina (Meigen)
				Protophormia terrae-novae R. D.
		Cecidomyiidae	X. 6	
				Thomasiniana ribis Mar.
		Ceratopogonidae	X. 7	
				Culicoides variipennis (Coq.)
		Chironomidae	X. 9	
				Chironomus plumosus
				Chironomus tentans
				Chironomus thummi
				Chironomus (Parachironomus) varus
				Glyptotendipes barbipes
				Smittia sp.
				Smittia parthenogenetica

Common Name(s)	Reference No.
flies	43, 254, 267, 290, 298, 337, 347, 556, 994, 1101, 1171, 1310
beet fly	948, 1482
blowflies	89, 460
blowfly	182, 215, 365
	32, 208-5, 361
screw-worm fly	1568, 1588, 1604
screw-worm fly	927, 1079, 1504, 1542, 1559, 1586, 1615
blowfly	809
	156, 161-2, 369
	596, 1569
black blowfly	94, 132-3, 142, 175, 268, 386, 389, 458-9, 1431
Northern blowfly; carrion fly	1166
gall midges	
	1716
biting midges	
	1309
midges	257, 263, 524, 528, 531
	1494
	72, 169, 180-1, 253, 256, 266, 284, 309, 324, 449, 450, 1492-4, 1513
	71-2, 180, 273, 298-4, 324, 922
	68
	294
	291
	342-5

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Diptera	Chloropidae	X. 10	
				Hippelates pusio Loew
				Oscinella frit (Linnaeus)
		Culicidae	X. 11	
				Aedes
				Aedes aegypti (Linnaeus)
				Aedes cataphylla (Dyar)
				Aedes communis
				Aedes dorsalis (Meigen)
				Aedes nigromaculis
				Aedes stimulans
				Aedes taeniorhynchus (Wiedemann)
				Aedes trichurus
				Aedes vexans
				Anopheles maculipennis atroparvus
				Anopheles pharoensis Theobald
				Anopheles quadrimaculatus (Say)
				Anopheles stephensi mysorensis (Sweet & Rao)
				Culex fatigans
				Culex nigripalpus
				Culex pipiens
				Culex pipiens fatigans Wiedemann
				Culex pipiens molestus Forsk.
				Culex pipiens quinquefasciatus Say

Common Name(s)	Reference No.
chloropid flies	
eye gnat	1471
frit fly	555
mosquitoes	22, 901-2, 1569, 1713
	529, 901-2
yellow fever mosquito	11, 37, 82, 226, 387, 422, 585, 621, 646, 656, 863, 926, 963, 1000, 1111, 1167-8, 1181, 1249, 1292, 1333, 1343, 1472, 1486, 1781
	318
	545
	318
	759
	545
black salt-marsh mosquito	1791
	11, 545
	78
	1364
	1544, 1583-5, 1595, 1600, 1610-2
common malaria mosquito	585, 1066
	501-2
	1607
	6
	88
	8, 500, 796
	25
Southern house mosquito	76, 822, 1791

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Diptera	Culicidae	X.11	Culex tarsalis Coquillet
				Culiseta impatiens (Walker)
				Culiseta inornata (Williston)
				Haplodiplosis equestris (Wagn.)
				Psorophora confinnis
				Psorophora signipennis
		Cuterebridae	X.12	
				Dermatobia hominis (Linnaeus, Jr.)
		Dolichopodidae	X.13	
				Chaetopsis aenea
				Chaetopsis apicalis
		Drosophilidae	X.14	
				Drosophila
				Drosophila affinis
				Drosophila ananassae
				Drosophila birchii
				Drosophila buskii
				Drosophila hydei Sturtevant
				Drosophila melanogaster *

* See p. 522.

Common Name(s)	Reference No.
	318
	318
	318
wheat-stem-gall mosquito	467
	1791
	318
rabbit bots, rodent bots	
human bot fly	1545, 1559
long-legged flies	525
	526
	526
vinegar flies	
pomace or vinegar fly	16, 28, 34, 36, 46, 75, 200-1, 239, 279, 303-4, 316-7, 320, 333, 357-9, 507, 908, 915, 931-2, 939, 946-7, 950-1, 953, 961-2, 970, 976, 980, 992, 1008, 1010, 1022-3, 1027, 1033, 1036-7, 1049, 1050, 1065, 1071, 1080, 1083, 1087, 1089, 1094, 1096, 1098, 1109, 1121, 1126, 1173, 1176-7, 1187, 1197, 1200, 1215, 1220, 1234-7, 1241-2, 1244-5, 1248, 1255-6, 1260, 1263, 1265-6, 1269, 1272, 1276, 1283, 1285, 1371, 1383, 1416-7, 1425, 1483, 1498, 1506
	1112
	945, 1011-2, 1513
	1404
	394, 450
	115-6, 237, 241-2, 262, 285, 328, 451, 1005, 1130
	*

* See p. 523.

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Diptera	Drosophilidae	X.14	Drosophila melanogaster (Meigen)
				Drosophila nebulosa
				Drosophila pseudoobscura
				Drosophila serrata
				Drosophila simulans
				Drosophila subobscura
				Drosophila tropicalis
				Drosophila virilis
				Drosophila willistoni
		Ephrididae	X. 15/16	
		Anthomyiidae	X. 18	
				Hylemya antiqua (Meigen)
				Pegomya hyoscyami (Panzer)
		Muscidae	X. 19	
				Fannia canicularis (Linnaeus)
				Glossina spp.
				Glossina, Glossina morsitans
				Haematobia irritans (Linnaeus)

Common Name(s)	Reference No.
	12, 20, 21, 26, 31, 33, 35, 74, 102, 118-9, 145, 150, 151, 153, 159, 160, 165-6, 183, 198, 210, 216, 227, 238, 241, 247, 264, 272, 276, 286-7, 292, 327, 335, 339, 350, 354, 378-9, 439, 447, 453, 465, 477, 782, 788, 917, 920-1, 937, 940, 942-5, 949, 955, 960, 965, 967, 977-8, 983-6, 989, 991, 998-9, 1004, 1006-7, 1009, 1013-4, 1018, 1021, 1024-6, 1028-9, 1030, 1034-5, 1038-9, 1040-5, 1048, 1057-9, 1062-4, 1067-9, 1070, 1073-6, 1081-2, 1084, 1086, 1090, 1092, 1095, 1097, 1099, 1105-6, 1110, 1139, 1140, 1147, 1151-2, 1155, 1174-5, 1178, 1180, 1185-6, 1188-9, 1190-1, 1194-6, 1198, 1201-12, 1214, 1218-9, 1221-9, 1230, 1232, 1240, 1243, 1246, 1250-1, 1253-4, 1259, 1261-2, 1264, 1270, 1273, 1278, 1280, 1282, 1284, 1500, 1502-3, 1507-9, 1510, 1513, 1515-9, 1520, 1613, 1725, 1744, 1785, 1791
	1505
	441, 1031, 1047, 1513
	1404, 1520
	336, 1464-5
	136, 1415, 1494, 1513
	1494
	143, 201, 277-8, 325-6, 952, 1323
	995, 1505, 1513
	525
antomyiid flies	
onion maggot	467, 1366
spinach leaf miner	911
house flies, stable flies, and allies	453
little house fly	1373
	124, 1559, 1565, 1712
tsetse fly	124, 126, 1559, 1565, 1712
horn fly	1591

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Diptera	Muscidae	X. 19	Musca domestica Linnaeus
				Musca domestica nebulo
				Phorbia brassicae Bouché
				Stomoxys calcitrans (Linnaeus)
		Mycetophilidae	X. 20	
				Sciara coprophila (Lintner)
		Oestridae	X. 21	
				Hypoderma
				Hypoderma bovis (Linnaeus)
		Phoridae	X. 23	
				Megaselia scalaris (Rondani 1856)
		Psychodidae	X. 27	
				Lutzomyia (Phlebotomus) longipalpis (Lutz and Neiva, 1912)
				Plebotomus longipalpis
		Sarcophagidae	X. 29	
				Sarcophaga bullata
				Sarcophaga peregrina Robineau-Desvoidy
		Sciaridae	X. 29a	
				Rhynchosciara angelae
		Simuliidae	X. 30	
				Simulium

Common Name(s)	Reference No.
house fly	9, 10, 92, 111, 138, 176, 232, 359, 365-8, 370, 380, 417-8, 437, 445, 459, 463, 466, 593-4, 596, 614-5, 624, 667, 670, 674, 680-1, 690, 698, 700, 702, 735, 750, 767, 797, 799, 806, 814-5, 836-7, 841, 843-4, 848-9, 851-2, 870, 874-7, 885, 887, 891-3, 896-7, 1046, 1113, 2162, 1169, 1170, 1233, 1295-6, 1308, 1314, 1380-1, 1421-2, 1501, 1569, 1747, 1791
	1372
cabbage fly	1608
stable fly	677, 815
fungus gnats	
	15, 270-1, 294, 331
bot and warble flies	
cattle grub	708, 784
Northern cattle grub; warble grub	174-5
humpbacked flies	
	1019
moth flies	
sandflies	7, 464
	563
flesh flies	
flesh fly	113, 398, 421
	1315, 1382
	268, 294, 305-6, 312-3, 323, 341
black flies	4, 24
	359

Class	Order	Family	Systematic Code	Scientific Name
INSECTA	Diptera	Tephritidae	X. 35	
				Anastrepha ludens (Loew)
				Ceratitis capitata (Wiedemann)
				Dacus ciliatus
				Dacus cucurbitae Coquillet
				Dacus dorsalis Hendel
				Dacus oleae (Gmelin)
				Dacus tryoni (Frogg)
				Dacus zonatus
				Rhagoletis pomonella (Walsh)
				Strumeta tryoni
		Tipulidae	X. 36	
				Tipula oleracea
	Siphonaptera	Pulicidae	Y.	
			Y. 2	
				Xenopsylla gerbilli (Rothschild)

Common Name(s)	Reference No.
fruit flies	1052, 1179, 1568-9, 1687
Mexican fruit fly	1559, 1603
Mediterranean fruit fly; medfly	2, 3, 14, 27, 557, 559, 1119, 1120, 1325, 1327, 1335, 1354, 1359, 1459, 1474, 1544-5, 1551, 1558, 1559, 1562, 1589, 1594-6, 1598-9, 1600-2, 1609, 1616-7, 1647, 1658, 1702
	1559
melon fly	1559, 1571, 1592, 1647, 1650, 1656
oriental fruit fly	1559, 1647, 1650, 1656
olive fruit fly	905, 1154, 1325, 1335, 1551, 1559, 1614
Queensland fruit fly	1587, 1597, 1623, 1679
	1559, 1593
apple maggot	754
Queensland fruit fly	1670, 1690
crane flies	
a crane fly	310
fleas	542
pulicid fleas	
	546, 566-7

TABLE 2. RADIOTRACER STUDIES ON INSECTICIDES[1, 2]

Data have been assembled in the following categories:

A. ACTIVATORS OR SYNERGISTS

B. BOTANICALS AND DERIVATIVES

C. CHLORINATED ARYL HYDROCARBONS (containing 6 or more chlorines)

D. DDT RELATIVES (diphenyl aliphatics)

F. FUMIGANTS

N. NICOTINE ALKALOIDS (including ANABASINE and related compounds)

P. PHOSPHORUS-CONTAINING COMPOUNDS

- A. ALIPHATIC DERIVATIVES
- C. ARYL (PHENYL) DERIVATIVES
- H. HETEROCYCLIC DERIVATIVES

R. CHEMOSTERILANTS

X. CARBAMATES

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[1] Chemical names and "other designations" for compounds cited in the bibliography have been compiled following the general lines of E.E. Kenaga's "Commercial and Experimental Organic Insecticides" (1963 Revision) in Bull. ent. Soc. Am. 9: 2, 1963, 67-103 and (1966 Revision) in ibid. 12: 2, 1966, 161-217, and in announcements of the Insecticide Terminology Committee published ibid. 12, 3 (1966) 356-7, 13, 4 (1967) 342, and 14, 4 (1968) 289. The chemical categories have been maintained, apart from slight modifications. — Two indexes (i) Common and Manufacturers' Names Index, and (ii) Letter-and-Number Index have been prepared.

[2] The chemical name used in accordance with the principles of Chemical Abstracts nomenclature is generally marked with an asterisk, * .

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis**	Metabolism	Residues
	ACTIVATORS OR SYNERGISTS FOR INSECTICIDES				
A.1	* a-[2-(2-butoxyethoxy)ethoxy]-4,5-methylenedioxy-2-propyltoluene butylcarbitol-6-propylpiperonyl ether	piperonyl butoxide Butocide	^{14}C [896]	Musca domestica Baygon synergist ^{14}C [897] carbamate synergist ^{14}C [897	
A.2	* piperonal bis[2-(2-butoxyethoxy)ethyl]acetal	Tropital			
	piperonal bis[2-(2-butoxyethoxy)ethyl] acetal-methylene	Tropital-methylene		rat ^{14}C [894]	rat (bile, urine) ^{14}C [894]
A.3	* acetaldehyde-2(2-ethoxyethoxy)ethyl 3,4-methylenedioxyphenyl acetal 2-(3,4-methylenedioxyphenoxy)-3,6,9-trioxaundecane	sesamex Sesoxane ® ENT 20871		Musca domestica sesamex-suppressible DDT-resistance ^{14}C [667]	
A.4	* 1,2-methylenedioxy-4-[2-(octylsulfinyl) propyl]benzene n-octyl sulfoxide of isosafrole	sulfoxide Sulfox-Cide ®	diastereoisomers ^{14}C [896]		

** If no other indication

A.5	dimethyl sulfoxide			pear tree penetration and distribution ^{35}S [895]	
A.6	methylenedioxyphenyl compounds		^{14}C [896]	Musca domestica ^{14}C [892, 893] rat ^{14}C [892]	
A.7	4-allyl-1,2-methylenedioxybenzene	safrole	4-allyl-1,2-methylene-^{14}C-dioxybenzene ^{14}C [896]		
A.8	4-propyl-1,2-methylenedioxybenzene	dihydrosafrole	4-propyl-1,2-methylene-^{14}C-dioxybenzene ^{14}C [896]		
A.9	5-allyl-1-methoxy-2,3-methylene-dioxybenzene	myristicin	5-allyl-1-methoxy-2,3-methylene-^{14}C-dioxybenzene ^{14}C [896]		
A.10	2,3-methylenedioxynaphthalene				Musca domestica synergistic action ^{3}H [840] ^{14}C [840] mammals synergistic action ^{3}H [840] ^{14}C [840]

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
		BOTANICALS AND DERIVATIVES			
B.1	rotenone (from plant species Derris and Lonchocarpus)	cubé derris rotenone powder and resins		Musca domestica ^{14}C [870] inhibition sites of amytal and peiricidin A ^{14}C [871] reaction sites respiratory chain soluble DPNH-coenzyme Q reductase ^{14}C [872] respiratory chain binding characteristics ^{14}C [871] reaction sites ^{14}C [872] mouse ^{14}C [851]	
B.2	pyrethrum (principally from plant species Chrysanthemum cinariaefolium)	pyrethrin I	^{14}C (natural ester plus diastereoisomer) [851]	Musca domestica in vivo and in vitro ^{14}C [852] sorption of synthetic pyrethrin I ^{14}C [851]	

		pyrethrin II pyrethrins cinerin I cinerin II cinerins		Musca domestica oxidation products ^{14}C [852] general studies ^{14}C [850] general studies ^{14}C [850]	
B.3	* 2,2-dimethyl-3-(2-methylpropenyl)cyclopropanecarboxylic acid ester with 2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one dl-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one esters of cis and trans dl-chrysanthemummonocarboxylic acids 3-allyl-2-methyl-4-oxo-2-cyclopenten-1-yl chrysanthemumate 2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one ester of 2,2-dimethyl-3-(2-methylpropenyl)-cyclopropanecarboxylic acid	allethrin allyl homologue of cinerin I synthetic pyrethrins Pynamin ENT 17510	labelled in ketol or acid portion ^{14}C [850]	Musca domestica in vivo and in vitro ^{14}C [852] metabolism ^{14}C [849]	
B.4	* 2,4-dimethylbenzyl 2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate 2,4-dimethylbenzyl chrysanthemumate 2,4-dimethylbenzyl ester of cis trans chrysanthemumic acid	dimethrin ENT 21170		Musca domestica in vivo and in vitro ^{14}C [852]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
B.5	* 3,4,5,6-tetrahydrophthalimidomethyl 2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate 2,3,4,5-tetrahydrophthalimidomethyl chrysanthemate 3,4,5,6-tetrahydrophthalimidomethyl cis and trans dl chrysanthemummonocarboxylic acid	Neo-pynamin ® phthalthrin ENT 27339 SP-1103		Musca domestica in vivo and in vitro ^{14}C [852]	
B.6	nicotine l-1-methyl-2-(3-pyridyl)-pyrrolidine l-3-(1-methyl-2-pyrrolidyl)-pyridine	Black leaf 40 ® nicotine (sulphate)	biosynthesis ^{14}C [675, 856-862, 868] ^{3}H [862] ^{3}H, ^{14}C [869] inhibition of ^{3}H, ^{14}C [867] effects of nutrient deficiencies on ^{3}H, ^{14}C [869] biosynthesis nicotine-2-^{3}H ^{3}H [863] synthesis DL-2-^{14}C-nicotine ring-labelled ^{14}C [853, 854] methyl-labelled ^{14}C [853, 854]	Aedes aegypti metabolism and toxicity ^{3}H [863] Arthrobacter oxidans metabolism of $^{14}CH_3$-L-nicotine ^{14}C [855] metabolism of 2'-^{14}C-DL-nicotine ^{14}C [855] dog ^{14}C [864] frog (sartorius muscle) contracture ^{14}C [866] effects on ^{45}Ca-movement rabbit ^{14}C [853]	

				rat ^{14}C [864] metabolism (system not specified) ^{14}C [857] tobacco leaves stereospecific demethylation ^{14}C [860]	
CHLORINATED ARYL HYDROCARBONS (containing 6 or more chlorines)					
C.0		organochlorine pesticides			plant ^{36}Cl [633]
C.1	* 1,2,3,4,5,6-hexachlorocyclohexane, mixed isomers	benzene hexachloride hexachloro-cyclohexane gammexane BHC HCH 666	analysis γ-HCH contents in HCH r.i. [1717] production and processing monitoring ^{36}Cl [679]	Boophilus decoloratus ^{14}C [614] mammals distribution in tissues (♂,♀) ^{14}C [683] rat distribution in tissues ^{14}C [683]	
C.2	* 1,2,3,4,5,6-hexachlorocyclohexane, 99% or more gamma isomer	lindane gamma BHC		fish elimination from ^{14}C [630] uptake ^{14}C [629]	

Index Codex	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
C.2 (ctd.)				microflora (soils, tropical) degradation by ^{14}C [655] soil decomposition by ^{14}C [692] soils, tropical -, degradation by ^{14}C [655]	soils persistence in tropical submerged -, ^{14}C [655]
C.3	* 1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene 1,2,4,5,8,7,10,10-octachloro-4,7,8,9-tetrahydro-4,7-endomethyleneindane	chlordane Octa-Klor ® Octachlor ® Velsicol 1068 1068		Aedes aegypti (l) ^{14}C [646] fungi (Aspergillus niger Penicillium notatum) ^{14}C [646] monkey chlordane: digoxin metabolism ^{3}H [651] mouse ^{14}C [646] rat ^{14}C [646]	
	α-chlordane			rabbit ^{14}C [654]	

C.4	* 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene + 1(3a),4,5,6,7,8,8-heptachloro-3a(1),4,7,7a-tetrahydro-4,7-methanoindene + 1,4,5,6,7,10,10-heptachloro-4,7,8,9-tetrahydro-4:7 endomethyleneindene + 4,5,6,7,9,10,10-heptachloro-4,7,8,9-tetrahydro-4,7-methanoindene	heptachlor Velsicol 104 ® E-3314		Aedes aegypti (ℓ) ^{14}C [646] fungi (Aspergillus niger Penicillium notatum) ^{14}C [646] mouse ^{14}C [646] rat ^{14}C [646]	
C.5	+ chlorinated camphene, containing 67-69% chlorine	toxaphene 3956 Melipax	synthesis semi-micro scale ^{36}Cl [640]	rape reinfestation by Meligethes aeneus after treatment ^{32}P [506]	honey ^{36}Cl [641] rape seed oil ^{36}Cl [641]
C.6	not less than 95% of + * 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo-exo-5,8-dimethanonaphthalene + hexachlorohexahydro-endo, exo-dimenthano-naphthalene	aldrin Octalene HHDN compound 118	decomposition products (non-metabolic) radiation [617] ozonation reaction on aldrin ^{14}C [612]	Aedes aegypti ^{14}C [646] dieldrin-R-: ^{14}C [585] Anopheles quadrimaculatus dieldrin-R-: ^{14}C [585] mouse ^{14}C [646] rabbit ^{14}C [645, 648] rat ^{14}C [645-7] distribution and elimination ^{14}C [645, 647] clays absorption ^{14}C [691]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
				soils ^{14}C absorption ^{14}C [691] fungi (Aspergillus niger, Penicillium notatum) ^{14}C [646]	
C.7	not less than 85% of * 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,-endo-exo-5,8-dimethanonaphthalene hexachloroepoxyoctahydro-endo, exo-dimethanonaphthalene	dieldrin Octalox HEOD compound 497	decomposition products (non-metabolic) radiation [617] double isotope derivative dilution analysis $^{3}H/^{14}C$ DBA† [609, 1729]	Aedes aegypti (♀) ^{14}C [646] Blattella germanica binding, interaction (nerve cord) ^{14}C [657] dieldrin: ion movement (CNS) ^{22}Na, ^{45}Ca [638] Musca domestica application method: toxicity and distribution ^{14}C [680, 681] R- and S- (CNS), uptake and metabolism ^{14}C [674]	residue analysis $^{3}H/^{14}C$ DBA† [609] rat retention ^{36}Cl [639] forage crops ^{14}C [688] ^{36}Cl [688]

†DBA = 6-acetoxy-7-bromo-6,7-dehydroaldrin

				Oncopeltus fasciatus(e) uptake ^{14}C [610] Periplaneta americana dieldrin: ion movement (CNS) ^{22}Na, ^{45}Ca [638] birds dieldrin: steroid metabolism ^{14}C [669] HeLa S cells DDT: NA synthesis, protein synthesis ^{14}C [613] mouse ^{14}C [646] rabbit ^{14}C [654] transport in pregnancy ^{14}C [636] rat ^{36}Cl [639] ^{14}C [646, 647, 678] distribution and elimination ^{14}C [647] toxicity ^{36}Cl [639] fish uptake ^{14}C [629]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
C.7 (ctd.)				fish elimination ^{14}C [630] forage crops root uptake and accumulation ^{36}Cl [666] soil microorganisms ^{14}C [660] Pseudomonas melophthora (apple maggot symbiont) ^{14}C [754] fungi (Aspergillus niger Penicillium notatum) ^{14}C [646] wool absorption r.i. [689] fastness properties r.i. [689]	
C.8	* 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-5,8-dimethanonaphthalene hexachloroepoxyoctahydro-endo, endo-dimethanonaphthalene	endrin compound 269		Aedes aegypti (l) ^{14}C [646] fungi (Aspergillus niger Penicillium notatum) ^{14}C [646]	

				mouse ^{14}C [646] rat ^{14}C [644, 646]	
C.9	* 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin 3-oxide	endosulfan Thiodan ® Malix BIO-5462 Hoe 2671 Niagara 5462	properties autoradiolysis ^{14}C [626]	fish ^{14}C [675] mouse ^{14}C [619] storage and excretion ^{14}C [619]	fish ^{14}C [675]
C.10	* 1,3,4,5,6,7,8,8-octachloro-3a,7,7a-tetrahydro-4,7-methanophthalan	Telodrin SD 4402 CP-14957		Aedes aegypti ^{14}C [646] Aspergillus niger ^{14}C [646] Penicillium notatum ^{14}C [646] mouse ^{14}C [646] rat ^{14}C [646]	
	DDT RELATIVES				
D.1	* 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane dichloro diphenyl trichloroethane	DDT Chlorophenothene	DDT-1-^{14}C [621] DDT-2-^{14}C [621] o-Cl-DDT-^{14}C [621]	Insects Aedes aegypti (ℓ) ^{14}C [621] Boophilus microplus ^{14}C [676]	Analysis $^{3}H/^{14}C$ [609] Insects Musca domestica retention ^{14}C [690]

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
D.1 (ctd.)			DDT-^{3}H [618] double isotope derivative dilution analysis $^{3}H/^{14}C$ [609, 1729] production monitoring ^{36}Cl [672]	cockroaches binding (nerve cord) ^{14}C [635] Blattella germanica (CNS) R- and S- ^{14}C [637] Periplaneta americana ^{14}C [690] (CNS) ^{14}C [622, 623, 658, 659] Heliothis virescens (*l*) ^{14}C [685, 686] distribution ^{14}C [685] penetration rate ^{14}C [685-7] Heptagenia hebe DDT-resistance ^{14}C [631] Musca domestica ^{14}C [690] ^{3}H [670] DDT: glucose utilization, protein synthesis, glutathione turnover ^{14}C [111, 615]	Oncopeltus fasciatus retention ^{14}C [690] Periplaneta americana retention ^{14}C [690]

				Musca domestica DDT: formate- and proline metabolism ^{14}C [138] sesamex-suppressible resistance ^{14}C [667] DDT and substituted derivatives, comparative toxicity ^{3}H [670] DDT-resistance ^{36}Cl [624] Oncopeltus fasciatus ^{14}C [690] uptake (e) ^{14}C [610] Stenonema interpunctatum DDT-resistance ^{14}C [631] Stomoxys calcitrans R- and S- ^{14}C [677] Triatoma infestans DDT: protein biosynthesis ^{14}C [110] toxicity ^{14}C [625] DDT: glutathione turnover ^{14}C [163]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
D.1 (ctd.)				Triatoma infestans DDT: glucose incorporation (protein; soluble intermediates) ^{14}C [104] Birds excretion by ^{14}C [634] ^{36}Cl [620] DDT: steroid metabolism ^{14}C [669] waterfowl ^{36}Cl [620] Mammals guinea pig DDT: cortisol production and metabolism ^{14}C [607] HeLa S cells DDT: cell biochemistry, NA synthesis, protein synthesis ^{14}C [613] monkey DDT: digoxin metabolism ^{3}H [651]	waterfowl ^{36}Cl [620] Animals (various) crayfish ^{36}Cl [662] fish ^{14}C [616] ^{36}Cl [661, 662] frog (tadpoles) ^{36}Cl [661, 662] rabbit ^{14}C [682] snails ^{14}C [616] snake (water-) ^{36}Cl [661, 662] vertebrates ^{36}Cl [661]

				mouse tolerance ^{14}C [608] rabbit resorption and excretion ^{14}C [682] DDT: plasmocytosis ^{198}Au: [627] rat binding (liver, muscle, brain) ^{14}C [635] DDT: plasmocytosis ^{198}Au: [627] DDT: dieldrin metabolism ^{14}C [678] DDT: protein metabolism (liver, cell-free) ^{14}C [673] animals DDT: plasmocytosis ^{198}Au: [628] Fish uptake ^{14}C [629] elimination ^{14}C [630] Animals (various) blood-sucking leeches (Hirudinaria manillensis Hirudo nipponia)	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
D.1 (ctd.)				blood-sucking leeches absorption and dehydrochlorination ^{14}C [643] Miscellaneous bacteria ^{14}C [677] yeast dechlorination by ^{14}C [642] soil distribution in ^{14}C [663] anaerobic degradation in ^{14}C [632] marsh ecosystem cycling ^{36}Cl [661,662] field tests ^{36}Cl [586] Plants barley R- and S-, DDT: photosynthesis ^{14}C [652] carrots ^{14}C [663,671]	Miscellaneous food chains ^{36}Cl [661] mud ^{14}C [616] soil ^{14}C [616,649] field tests ^{36}Cl [586] plants ^{36}Cl [661] carrots ^{14}C [663,671] potatoes ^{14}C [649] weeds ^{36}Cl [662]

				rape reinfestation by Meligethes aeneus after aerosol treatment ^{32}P [506]	
D.2	* 1,1-dichloro-2,2-bis(p-chlorophenyl)ethane dichlorodiphenyl dichloroethane tetrachlorodiphenylethane	TDE Rhothane ® DDD			carrots ^{14}C [671]
D.3	* isopropyl 4,4'-dichlorobenzilate	Chloropropylate ® G 24163		soil microorganisms ^{14}C [664] Trichoderma viride (soil fungus) ^{14}C [664]	
		FUMIGANTS			
F.1	* carbon tetrachloride	tetrachloromethane CCl_4		rat ^{14}C [668] effect of diet on CCl_4-metabolism ^{14}C [603]	
F.2	cyanide		^{14}C [592, 595, 604, 605]	Lotus arabicus ^{14}C [592] Lotus tenuis ^{14}C [592]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
F.3	* naphthalene			Musca domestica R- and S-, detoxication ^{14}C [594]	
F.4	* sulfuryl fluoride	Vikane ®	^{35}S [601]	insect eggs ^{35}S [601] Schistocerca gregaria uptake and metabolism (e) ^{35}S [599,600] Tenebrio molitor uptake (e) ^{35}S [599,600]	
PHOSPHORUS CONTAINING COMPOUNDS ALIPHATIC DERIVATIVES					
PA.1	* dimethyl (2,2,2-trichloro-1-hydroxyethyl)-phosphonate	trichlorfon Dipterex ® Dylox ® Neguvon ® chlorophos Trichlorphon Tugon Bayer L13/59 ENT 19763	^{32}P [743] ^{35}S [743] via chloral ^{3}H [618]	insects absorption and metabolism ^{32}P [701] chewing- ^{32}P [739] sucking- ^{32}P [739]	

				cattle ^{32}P [708, 786] resorption (percutaneous) ^{32}P [713, 784] (udder) ^{32}P [706, 787] excretion ^{32}P [709] metabolism in serum ^{32}P [715] milk ^{32}P [709] veterinary medicine applications in metabolic studies Rev., r.i. [710] fungus (Fusarium sp.) ^{14}C [732] cotton plant ^{14}C [732]	
PA.2	(Systox-type of compound)	tinox	protective materials permeability ^{32}P [707]	cattle ^{32}P [708] tomato metabolism of tinox-isomers ^{32}P [711]	cattle ^{32}P [708]
PA.3	* 2,2-dichlorovinyl dimethyl phosphate O,O-dimethyl 2,2-dichlorovinyl phosphate	dichlorvos Vapona ® Herkol DDVP	protective materials permeability ^{32}P [707]	Oncopeltus fasciatus uptake (e) ^{14}C [610]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PA.3 (ctd.)				cattle polymer/insecticide as feed additive ^{14}C [752] resorption (udder) ^{32}P [706] rat absorption after oral administration ^{32}P [653] Pseudomonas melophthora (apple maggot symbiont) ^{14}C [754]	
PA.4	* dimethyl phosphate, ester with cis 3-hydroxy-N-methylcrotonamide – dimethyl phosphate of 3-hydroxyl-N-methyl-cis-crotonamide – dimethyl 1-methyl-2-(methylcarbamoyl) vinyl phosphate, cis	Azodrin® SD 9129	^{14}C [698]	Anthonomus grandis (a) ^{14}C [700] ^{32}P [700] Heliothis virescens (f5) ^{14}C [700] ^{32}P [700] Heliothis zea (f5) ^{14}C [700] ^{32}P [700] Musca domestica (a) ^{14}C [700] ^{32}P [700]	

				Periplaneta americana (a) ^{14}C [700] ^{32}P [700] rat ^{14}C [700] ^{32}P [700] cotton plant ^{32}P [751] distribution in ^{32}P [775] systemic activity in ^{32}P [775]	cotton plant ^{32}P [775]
PA.5		Bidrin® SD 3562	methoxy-labelled ^{14}C [698]	cotton plant ^{32}P [751]	
PA.6	* dimethyl phosphate, ester with 2-chloro-N,N-diethyl-3-hydroxycrotonamide – 2-chloro-2-diethylcarbamoyl-1-methylvinyl dimethyl phosphate – 1-chloro-1-diethylcarbamoyl-1-propen-2-yl dimethyl phosphate	phosphamidon Dimecron® ML-97 OR-1191	^{32}P [702] carbonyl-labelled ^{14}C [702] methyl-vinyl-labelled ^{14}C [702]	Anthonomus grandis (a) ^{14}C [702] ^{32}P [702] Heliothis virescens (l5) ^{14}C [702] ^{32}P [702] Heliothis zea (l) ^{14}C [702] ^{32}P [702] Musca domestica (a) ^{14}C [702] ^{32}P [702]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PA.6 (ctd.)				goats ^{32}P [704] rat ^{32}P [704] cotton plants ^{14}C [702] ^{32}P [702]	
PA.7	* O,O-diethyl S-(ethylthio)methyl phosphorodithioate O,O-diethyl S-ethylmercaptomethyl dithiophosphate	phorate Thimet ® AC 3911 L 11/6		maize ^{32}P [798]	millet seed ^{35}S [742]
PA.8	* O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate	disulfoton Di-Syston ® FRUMIN AL ® SOLVIREX ® dithiodemeton Thiodemeton Bayer 19639		Heliothis zea ^{32}P [699] cotton plant effectiveness (field) ^{32}P [776] cotton seed effectiveness (field) ^{32}P [776]	
PA.9	* diethyl mercaptosuccinate, S-ester with O,O-dimethyl phosphorodithioate O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate O,O-dimethyl S-(1,2-dicarbethoxyethyl) dithiophosphate	malathion Malathon 4049	^{32}P [741, 743] ^{35}S [743]	Musca domestica ^{14}C [1791] Oncopeltus fasciatus uptake ^{14}C [610]	

	+ S-[1,2-bis(ethoxycarbonyl)-ethyl] O,O-dimethyl phosphorodithioate + O,O-dimethyl phosphorodithioate ester with diethyl mercaptosuccinate			cattle (heifer) ^{32}P [794] hen nematodes elimination ^{32}P [794] man (liver) ^{14}C [835] rat (liver) ^{14}C [835] Pseudomonas sp. ^{14}C [757] Trichoderma viride (soil fungus) ^{14}C [757] soil degradation in ^{14}C [757] field tests ^{35}S [586]	cattle (heifer) (thymus, thyroid, meat, pancreas, liver, bone) ^{32}P [794] cotton persistence in ^{14}C [695] field tests ^{35}S [586]
PA.10	+ O,O-dimethyl S-[2-(1-methylcarbamoylethyl)-thio]ethyl phosphorothioate	vamidothion Vamidothion Vamidoate RP-9895		insects in vivo and in vitro ^{32}P [763] Periplaneta americana (fat body, gut, muscle) ^{32}P [763] mouse in vivo and in vitro ^{32}P [763] plants ^{32}P [763]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PA.11	O,O-dimethyl-1-butyryloxy-2,2,2-trichlorethylphosphonate dimethyl (2,2,2-trichloro-1-hydroxyethyl)-phosphonate butyrate	Butonate ENT 20852	protective materials permeability ^{32}P [712]	blood (lactating cow) ^{32}P [706] cattle ^{32}P [706, 716] resorption (udder) ^{32}P [706] toxicity ^{32}P [716] apples ^{32}P [715] plums ^{32}P [715] wheat ^{32}P [715]	blood (lactating cow) ^{32}P [715, 716] milk (cow) ^{32}P [715, 716] apples ^{32}P [715] plums ^{32}P [715] wheat ^{32}P [715]
PA.12	* O,O-dimethyl S-(methylcarbamoylmethyl) phosphorodithioate O,O-dimethyl S-(N-methylcarbamoylmethyl) phosphorodithioate O,O-dimethyl S-α-mercapto-N-methylacetamido dithiophosphate methyl dimethyl dithiophosphoryl acetamide	dimethoate Cygon ® PERFEKTHION ® Rogor ® Roxion ® AC 12880 ENT 24650 NC-262		insects in vivo and in vitro ^{32}P [763] Musca domestica ^{3}H [797] -/EPN: metabolism ^{3}H [797] Oncopeltus fasciatus ^{3}H [797]	apples ^{32}P [696, 769] apricots ^{32}P [769] cacao beans ^{32}P [717] cherry ^{32}P [769] grapefruit ^{32}P [769]

				-/EPN: metabolism ^{3}H [797] uptake (e) ^{3}H [610] Periplaneta americana (fat body, gut, muscle) ^{32}P [783] cattle resorption (percutaneous) ^{32}P [713] (udder) ^{32}P [706] application and metabolism ^{32}P [714] guinea pig ^{3}H [797] -/EPN: metabolism ^{3}H [797] mouse ^{3}H [797] -/EPN: metabolism and toxicity ^{3}H [797] in vivo and in vitro ^{32}P [763] plants ^{32}P [763] apples ^{32}P [769] apricots ^{32}P [769]	grapes ^{32}P [769] olives ^{32}P [769] olive oil ^{32}P [696] peaches ^{32}P [769] spinach ^{32}P [777, 778] t.i. [779] tangerines ^{32}P [769]

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
				bean plants ^{14}C [753] ^{32}P [753] cherry ^{32}P [769] grapefruit ^{32}P [769] grapes ^{32}P [769] olives ^{32}P [769] peaches ^{32}P [769] tangerines ^{32}P [769] Theobroma cacao (cacao tree) translocation in ^{32}P [717] soil movement in ^{32}P [781]	
PA.13	* tetramethylphosphorodiamidic fluoride bis(dimethylamino)fluorophosphine oxide	dimefox Terra Sytam ® Hanane DMF Pestox 14	^{32}P [748]	hops ^{32}P [748]	hop leaves ^{32}P [748]

PHOSPHORUS ARYL (PHENYL) DERIVATIVES					
PC. 1	* O,O-dimethyl O-p-nitrophenyl phosphorothioate O,O-dimethyl O-p-nitrophenyl thiophosphate dimethyl p-nitrophenyl thionophosphate dimethyl p-nitrophenyl phosphorothionate	methyl parathion Metron methyl homologue of parathion Nitrox Bayer E-601		Bombyx mori (ℓ) (midgut) ^{32}P [725] Chilo suppressalis (ℓ) ^{32}P [724, 788] Musca domestica ^{32}P [735] Periplaneta americana (a) ^{32}P [788] Xylotrupes dichotomus (ℓ) ^{32}P [724, 725] mouse ^{32}P [734, 736] toxicity ^{32}P [736] rat ^{32}P [724] liver ^{32}P [725] liver homogenates ^{32}P [788] carrots distribution and hydrolysis ^{32}P [719] cauliflower ^{32}P [788]	carrots ^{32}P [718]

Code Index	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PC. 2	* O,O-diethyl O-p-nitrophenyl phosphorothioate O,O-diethyl O-p-nitrophenyl thiophosphate diethyl p-nitrophenyl thionophosphate diethyl p-nitrophenyl phosphorothionate	parathion Alkron ® Niran ® THIOPHOS ® Amer. Cyan. 3422 Bayer E-605	^{32}P [741]	Aedes aegypti R- and S- ^{32}P [759] Chilo suppressalis (f) ^{32}P [788] cockroach (fat body) ^{35}S [766] Periplaneta americana (a) ^{35}S [766, 788] Macrosiphum pelargonii ^{35}S [802] Musca domestica ^{35}S [766] Planococcus citri uptake ^{35}S [802] Trialeurodes vaporariorum ^{35}S [802] cat ^{32}P [723] guinea pig (liver microsomes) ^{32}P [768] man ^{32}P [723]	Macrosiphum pelargonii after 24 h ^{35}S [802] Planococcus citri after 24 h ^{35}S [802] Trialeurodes vaporariorum after 24 h ^{35}S [802]

				rabbit ^{32}P [723] liver microsomes ^{32}P [768] ^{35}S [766] rat ^{32}P [723, 765, 768] ^{35}S [765] liver homogenates ^{32}P [788] liver microsomes ^{32}P [768] ^{35}S [768] fish ^{14}C [761] fresh-water mussels (Elliptio complanatus) ^{14}C [761] water translocation in ^{14}C [761] Pseudomonas melophthora (apple maggot symbiont) ^{3}H [754] bean plant ^{35}S [802] uptake, translocation, accumulation ^{35}S [802] cauliflower ^{32}P [788]	
PC, 3	mixture of parathion and methyl parathion	metafos	production monitoring r.i. [1717]		

Code Index	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PC. 4	dimethyl p-nitrophenyl phosphate O,O-dimethyl O-p-nitrophenyl phosphate	methyl paraoxon			Chilo suppressalis (f) ^{32}P [788] Periplaneta americana (a) ^{32}P [788] rat (liver homogenates) ^{32}P [788] cauliflower ^{32}P [788]
PC. 5	* diethyl p-nitrophenyl phosphate O,O-diethyl O-p-nitrophenyl phosphate	paraoxon oxygen analogue of parathion Bayer E-600			cat ^{32}P [723] man ^{32}P [723] rabbit ^{32}P [723] rat ^{32}P [723]
PC. 6	* O-ethyl O-p-nitrophenyl phenylphosphonothioate ethyl p-nitrophenyl benzene thiophosphonate O-ethyl O-p-nitrophenyl benzenethiophosphonate	EPN EPN-300		Musca domestica effect on dimethoate metabolism ^{3}H [797] Oncopeltus fasciatus effect on dimethoate metabolism ^{3}H [797]	

				guinea pig effect on dimethoate metabolism and toxicity ^{3}H [797] mouse effect on dimethoate metabolism and toxicity ^{3}H [797]	
PC. 7	* O,O-dimethyl O-(4-nitro-m-tolyl) phosphorothioate – O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate	Folithion ® Sumithion ® fenitrothion Bayer 41831 Sumitomo S-1102A		Bombyx mori (ℓ) (midgut) ^{32}P [725] Chilo suppressalis (ℓ) ^{32}P [788] Musca domestica ^{32}P [735] Periplaneta americana (a) ^{32}P [788] Xylorrupes dichotomus (ℓ) ^{32}P [725] mouse ^{32}P [734, 736] toxicity ^{32}P [736] rat liver ^{32}P [725] liver homogenates ^{32}P [788]	rice ^{32}P [762]

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PC. 7 (ctd.)				cauliflower ^{32}P [788]	
PC. 8	* O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate	ronnel Etrolene® fenchlorphos Korlan® Nankor® Ronnel® Trolene® Viozene® Dow ET-14 Dow ET-57	^{32}P [746]		cattle (lactating cow) ^{32}P [746] meat ^{32}P [758] milk ^{32}P [746, 758]
PC. 9	* O-(4-bromo-2,5-dichlorophenyl) O,O-dimethyl phosphorothioate O,O-dimethyl-O-2,5-dichloro-4-bromophenyl thionophosphate O,O-dimethyl-O-2,5-dichloro-4-bromophenyl phosphorothioate	bromophos Nexion® S-1942 Cela S-2225		rat ^{3}H [795] ^{32}P [795] absorption, distribution ^{3}H [795] ^{32}P [795] plants penetration and effectiveness ^{32}P [738]	
PC. 10	* O-4-tert-butyl-2-chlorophenyl O-methyl methylphosphoramidate	Dowco® 132 Ruelene®			meat ^{32}P [758] milk ^{32}P [758]

PC. 11	* O,O-dimethyl O-[4-(methylthio)-m-tolyl] phosphorothioate O,O-dimethyl O-(3-methyl-4-methylmercapto-phenyl) phosphorothioate O,O-dimethyl O-4-(methylmercapto)-3-methylphenyl thiophosphate	fenthion BAYTEX ® ENTEX Lebaycid TIGUVON Bayer 29493 ENT 25540 S 1752		Cimex lectularius ^{35}S [801] absorption ^{35}S [801] Culex fatigans (l) absorption ^{32}P [796] resistance mechanism ^{32}P [796] Stomoxys calcitrans ^{35}S [801] absorption ^{35}S [801] cattle (lactating cow) ^{32}P [747]	cattle (lactating cow) ^{32}P [747] milk ^{32}P [747]
PC. 12	* O,O-diethyl O-p-(methylsulfinyl) phenyl phosphorothioate	Dasanit TERRACUR-P ® fensulfothion Bayer 25141 ENT 24945		cotton plant ^{32}P [745]	
PC. 13	* O-p-(dimethylsulfamoyl)phenyl O,O-dimethyl phosphorothioate	famphur WARBEX ® Famophos CL 38023		Oncopeltus fasciatus uptake (e) ^{3}H [610] cattle (calf) ^{3}H [727] polymer/insecticide as feed additive ^{14}C [752]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PC.13 (ctd.)				sheep ^{3}H [727]	
PC.14	* ethyl mercaptophenylacetate, O,O-dimethyl phosphorodithioate + ethyl ester of O,O-dimethyldithiophosphoryl α-phenyl acetic acid	PAPTHION ® Cidial ® Phenthoate BAY 33051 ENT 27386 L 561			apples ^{32}P [696] olive oil ^{32}P [696]
PC.15	* α-methylbenzyl 3-hydroxycrotonate dimethyl phosphate + dimethyl phosphate of α-methylbenzyl 3-hydroxy-cis-crotonate + alpha-methylbenzyl 3-hydroxycrotonate dimethyl phosphate	Ciodrin ® SD-4294			meat ^{32}P [758] milk ^{32}P [758]
PC.16	* 2-chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate	compound 4072 SD-7859	β-isomer ^{14}C [698]	Musca domestica (head homogenates) sorption ^{14}C [698] dog ^{14}C [737] mammals (blood) sorption ^{14}C [698] rat ^{14}C [737]	cattle after spraying ^{32}P [740] meat ^{32}P [758] milk ^{32}P [758]

PC.17	* 2-chloro-1-(2,3,5-trichlorophenyl)vinyl dimethyl phosphate	SD 8447	8-isomer of 1,2-^{14}C-SD 8447 [698]	Heliothis zea toxicity [799] Macrosiphum pisi toxicity ^{32}P [799] Musca domestica toxicity ^{32}P [799] sorption (head homogenates) ^{14}C [698] Sitophilus oryzae ^{32}P [799] Tetranychus telarius ^{32}P [799] dog ^{14}C [694] mammals (blood) sorption ^{14}C [698] rat ^{14}C [694] ^{32}P [799] toxicity ^{32}P [799]	
PC.18	2-chloro-1(2',4'-dichlorophenyl) vinyl diethyl phosphate	chlorfenvinphos Birlane® (Shell Reg. Trade Mark)			cabbage ^{14}C [697] carrots ^{14}C [697] onion ^{14}C [697]

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
					soil ^{14}C [697]
PC.19	O-methyl O-p-methylthiophenyl methylphosphonothionate			cotton plant ^{32}P [705, 774] uptake and translocation ^{32}P [705, 774]	
PC.20	O-O-diethyl O-[^{35}S-4-(methylthio)-3,5-xylyl] phosphorothioate	Bayer 9017	^{35}S [801]	cattle (dairy calves) ^{35}S [801]	cattle (dairy calves) ^{14}C, ^{35}S [801]
PHOSPHORUS HETEROCYCLIC DERIVATIVES					
PH.1	* O-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) O,O-diethyl phosphorothioate + O,O-diethyl O-3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl-phosphorothioate + O-(3-chloro-4-methylumbelliferone) O,O-diethyl phosphorothioate + O,O-diethyl O-(3-chloro-4-methyl-7-coumarinyl) phosphorothioate + 3-chloro-4-methylumbelliferone, O,O-diethyl thiophosphate	coumaphos ASUNTOL® CO-RAL® MUSCATOX® Resistox Bayer 21/199 ENT 17957		Boophilus microplus (♀) ^{32}P [780]	meat ^{32}P [758] milk ^{32}P [758]

PH.2	* S-S'-p-dioxane-2,3-diyl O,O-diethyl phosphorodithioate (cis and trans isomers) + 2,3-p-dioxanedithiol S,S-bis (O,O-diethyl phosphorodithioate) + p-dioxane-2,3-diyl ethyl phosphorodithioate)	dioxathion Delnav® Navadel ENT 22897 Hercules AC-528	analysis separation of components ^{32}P [783]		meat ^{32}P [758] milk ^{32}P [758]
PH.3	* S-((2-methoxy-5-oxo-Δ^2-1,3,4-thiadiazolin-4-yl)methyl) O,O-dimethyl phosphorodithioate + O,O-dimethyl-S-[2-methoxy-1,3,4-thiadiazole-5-(4H)onyl-(4)-methyl]dithiophosphate	GS-13005		bean plant foliage ^{14}C [720]	
PH.4	* O,O-dimethyl S-phthalimidomethyl phosphorodithioate + N-(mercaptomethyl)-phthalimide S-(O,O-dimethyl phosphorodithioate) + phthalimidomethyl O,O-dimethyl phosphorodithioate	Imidan® Prolate® R-1504 Stauffer R-1504		rat ^{14}C [722]	rat ^{14}C [722]
PH.5	* O,O-diethyl O-(3,5,6-trichloro-2-pyridyl) phosphorothioate	Dursban® Dowco® 179	synthesis semi-micro scale ^{14}C [764]	fish ^{14}C [789, 790] ^{36}Cl [789] rat ^{14}C [789] ^{36}Cl [789, 792] bean plants uptake and translocation ^{14}C [791] ^{36}Cl [791] corn plants uptake and translocation ^{14}C [791] ^{36}Cl [791] plants absorption, translocation, metabolism ^{14}C [789, 790, 793] ^{36}Cl [789, 793]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PH. 5 (ctd.)				soil ^{14}C [790]	
PH. 6	* O,O-diethyl O-2-pyrazinyl phosphorothioate	Nemafos® NEMAPHOS® ZINOPHOS® Cynem AC 18133		soil ^{14}C [729]	soil persistence in ^{14}C [728]
PH. 7	* O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate O,O-diethyl O-(2-isopropyl-4-methyl-6-pyrimidyl) phosphorothioate O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidyl) thiophosphate	diazinon Diazinon® Basudin G-24480		Boophilus microplus (ℓ) ^{14}C [782] distribution ^{14}C [782] Musca domestica (ℓ) permeability ^{32}P (i) [750] cattle polymer/insecticide as feed additive ^{14}C [752] fish ^{14}C [761] fresh-water mussels (Elliptio complanatus) ^{14}C [761] water translocation in ^{14}C [761]	

				Pseudomonas melophthora (apple maggot symbiont) ^{14}C [754] bean plant ^{14}C [744] absorption ^{14}C [744] distribution ^{14}C [730] wheat grain ^{14}C [744] absorption ^{14}C [744] soil ^{14}C [729] distribution in ^{14}C [730] degradation by ^{14}C [749]	bean plant ^{14}C [730, 744] soil ^{14}C [728, 730] wheat grain ^{14}C [744]
PH. 8	* O,O-dimethyl S-4-oxo-1,2,3-benzotriazin-3(4H)-ylmethyl phosphorodithioate O,O-dimethyl-S-(benzaziminomethyl) dithiophosphate S-(3,4-dihydro-4-oxo-1,2,3-benzotriazin-3-ylmethyl) O,O-dimethyl phosphorodithioate 3-(mercaptomethyl)1,2,3-benzotriazin-4-(3H)-one O,O-dimethyl phosphorothioate benzotriazine derivative of a methyl dithiophosphate O,O-dimethyl phosphorodithioate S-ester with 3-(mercaptomethyl)-1,2,3-benzotriazin-4(3H)-one	azinphosmethyl Gusathion® Guthion® AZINPHOS-methyl Bayer 9027 Bayer 17147 17/147			cattle (tissue) from treated forage ^{32}P [721] milk ^{32}P [721]

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
PH. 9	* S-(4,6-diamino-s-triazin-2-ylmethyl) O,O-dimethyl phosphorodithioate – S-(4,6-diamino-1,3,5-triazin-2-ylmethyl) dimethyl phosphorothiolothionate	menazon Saphos ® Saphizon PP 175		rat ^{14}C [703, 726] ^{32}P [703] toxicity ^{14}C [703] ^{32}P [703] plants ^{14}C [703] ^{32}P [703]	
	CHEMOSTERILANTS				
R. 1	* 2,2,4,4,6,6-hexakis (1-aziridinyl)-2,2,4,4,6,6-hexahydro-1,3,5,2,4,6-triazatriphosphorine – 2,2,4,4,6,6-hexahydro-2,2,4,4,6,6-hexakis (1-aziridinyl)-1,3,5,2,4,6-triazatriphosphorine – hexakis (1-aziridinyl)phosphonitrile	apholate ENT 26316 OM 2174 SQ 8388		Musca domestica effect on NA metabolism (e) ^{14}C [887] chromosome aberrations (species not specified) ^{14}C [883] ^{32}P [883]	
R. 2	* tris(1-aziridinyl)phosphine oxide	tepa aphoxide APO ENT 24915		Anthonomus grandis absorption and translocation ^{14}C [881] turnover ^{14}C [882]	

				Musca domestica ^{14}C [875] sterilization ^{14}C [875] Porthetria dispar (a, ♂) ^{14}C [878] Spodoptera frugiperda distribution in ^{14}C [884] chromosome aberrations (species not specified) ^{14}C [883] ^{32}P [883]	Spodoptera frugiperda persistence in ^{14}C [879]
R.3	* tris(1-aziridinyl)phosphine sulphide	thiotepa		Musca domestica effect on NA metabolism (e) ^{14}C, ^{32}P [887] rat breast cancer, concentration in tissue ^{14}C [880] chromosome aberrations (species not specified) ^{14}C [883] ^{32}P [883]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
R.4	hexamethylphosphoric triamide	hempa HMPA ENT 50882	analysis, purification ^{14}C [890]	Trichoplusia ni (f5) ^{14}C [889] Musca domestica ^{14}C [874, 877] sterilization ^{14}C [874, 877]	
R.5	triphenyltin			rat ^{113}Sn [639] guinea pig ^{113}Sn [639]	rat retention ^{113}Sn [639] guinea pig retention ^{113}Sn [639]
R.6	2-imidazolidinone			Musca domestica biochemical effects (various) ^{14}C [891]	
R.7	5-fluorouracil			Musca domestica sterilization ^{14}C [885]	

CARBAMATES					
X.1	* o-isopropoxyphenyl methylcarbamate 2-isopropoxyphenyl methylcarbamate	Baygon® UNDEN® propoxur Bayer 9010 Bayer 39007	^{14}C [827] carbonyl-labelled ^{14}C [827] methyl-labelled ^{14}C [827]	Musca domestica ^{14}C [837] $NADPH_2$ system ^{14}C [843, 844] albumin enhancement of oxidative metabolism ^{14}C [844] Baygon + piperonyl butoxide ^{14}C [897] Oncopeltus fasciatus uptake (e) ^{14}C [610] rat ^{14}C [827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [803] persistent glucoside metabolites in ^{14}C [830] foliage ^{14}C [804]	rat ^{14}C [827]
X.2	* 4-(methylthio)3,5-xylyl methylcarbamate	MESUROL® mercaptodimethur Bayer H-321 Bayer 9026 Bayer 37344 ENT-25726	carbonyl-labelled ^{14}C [827]	Musca domestica ^{14}C [837] albumin enhancement of oxidative metabolism ^{14}C [844]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
X.2 (ctd.)				$NADPH_2$ system ^{14}C [843, 844] rat ^{14}C [827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [803, 829] persistent glucoside metabolites ^{14}C [830] foliage ^{14}C [804]	rat persistence in ^{14}C [827]
X.3	* 4-dimethylamino-m-tolyl methylcarbamate	MATACIL® aminocarb arprocarb Bayer 44646 ENT-25784		Culex pipiens quinquefasciatus resistance ^{14}C [822] Musca domestica ^{14}C [837] albumin enhancement of oxidative metabolism ^{14}C [844] $NADPH_2$ system ^{14}C [843, 844] rat ^{14}C [827, 828, 839]	rat persistence in ^{14}C [827]

X.3 (ctd.)				bean plant ^{14}C [803, 829] persistent glucoside metabolites ^{14}C [830] foliage ^{14}C [804, 805]	
X.4	* 4-dimethylamino-3,5-xylyl methylcarbamate	Zectran® Dowco 139® ENT 25766	carbonyl-labelled ^{14}C [827, 830] methyl-labelled ^{14}C [827]	Musca domestica $NADPH_2$ system ^{14}C [843] rat ^{14}C [827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [803, 829] persistent glucoside metabolites ^{14}C [830] foliage ^{14}C [804, 805]	
X.5	* 1-naphthyl methylcarbamate 1-naphthyl N-methylcarbamate α-naphthyl N-methylcarbamate	carbaryl Sevin® 7744	carbonyl-labelled ^{14}C [827] methyl-labelled ^{14}C [827] reaction conditions ^{14}C [842]	acetylcholinesterase inhibition ^{14}C [846] Anthonomus grandis ^{14}C [807, 815] absorption ^{14}C [815] Heliothis zea (l,a) ^{14}C [807]	residues r.i. [819] cattle (lactating cow) ^{14}C [817]

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
X.5 (ctd.)			gas chromatographic results, verification of ^{14}C [842]	Musca domestica absorption and metabolism ^{14}C [815] albumin enhancement of oxidative metabolism ^{14}C [844] $NADPH_2$ system ^{14}C [843, 844] with synergist ^{3}H, ^{14}C [840] Oncopeltus fasciatus uptake (e) ^{3}H [610] Prodenia litura ^{14}C [823, 847] Pseudomonas melophthora (apple maggot symbiont) ^{3}H [754] Sitophilus oryza absorption and metabolism ^{14}C [815] Stomoxys calcitrans absorption and metabolism ^{14}C [815]	

				cattle (lactating cow) ^{14}C [817] mammals with synergist ^{3}H, ^{14}C [840] man (liver) ^{3}H [835] ^{14}C [835] mouse ^{14}C [832] rabbit ^{14}C [832] rat ^{14}C [827, 828, 832] liver ^{3}H [835] ^{14}C [835] liver microsomes ^{14}C [839] bean plant ^{14}C [803, 829] persistent glucoside metabolites ^{14}C [830] foliage ^{14}C [804] cotton plant translocation and metabolism ^{14}C [838]	
X.6	* 1-(dimethylcarbamoyl)-5-methyl-3-pyrazolyl dimethylcarbamate	dimetilan Dimetilan®		Blattella germanica ^{14}C [848]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
	2-dimethylcarbamyl-3-methylpyrazolyl-(5)-dimethylcarbamate 2-dimethylcarbamoyl-3-methyl-5-pyrazolyl dimethylcarbamate	Dimetilane GS-13332		Musca domestica ^{14}C [848] Periplaneta americana ^{14}C [848] cattle polymer/insecticide as feed additive ^{14}C [752] rat ^{14}C [827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [829] persistent glucoside metabolites ^{14}C [830]	
X.7	* 2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate 2,3-dihydro-2,2-dimethylbenzofuranyl-7-N-methylcarbamate	ENT 27164 NIA 10242 Furadan		cattle (lactating cow) ^{14}C [824]	
X.8	* 2-methyl-2-(methylthio) propionaldehyde O-(methylcarbamoyl) oxime	Temik® ENT 27093 UC 21149	S-methyl-labelled ^{14}C [812] N-methyl-labelled ^{14}C [812] tert-labelled ^{14}C [812]	Anthonomus grandis ^{14}C [806, 813, 814] ^{35}S [806, 813, 814] Heliothis virescens (ℓ) ^{14}C [814] ^{35}S [814]	

				Heliothis zea (ℓ) ^{14}C [813, 814] ^{35}S [813, 814] Musca domestica ^{14}C [759, 806, 814, 837] ^{35}S [806, 814] cattle (lactating cow) ^{35}S [818] rat ^{14}C [808, 826] ^{35}S [806, 808] cotton plant r.i. [834] ^{14}C [836] leaves ^{14}C [816] ^{35}S [816] soil r.i. [834] ^{35}S [816]	milk ^{35}S [818] rat ^{14}C [826]
X.9	* 1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate dimethyl 5-(1-isopropyl-3-methylpyrazolyl)-carbamate	Isolan® G 23611	carbonyl-labelled ^{14}C [830]	Musca domestica $NADPH_2$ system ^{14}C [843] rat ^{14}C [827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [829] persistent glucoside metabolites ^{14}C [830]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
X.10	6-chloro-3,4-xylyl methylcarbamate(1) 6-chloro-4,5-xylyl methylcarbamate (2) 2-chloro-4,5-xylyl methylcarbamate (2)	Banol® Sok Upjohn U-12927	carbonyl-labelled ^{14}C [827, 830] N-methyl-labelled ^{14}C [820, 827]	Blaberus giganteus (fat body) ^{14}C [821] Musca domestica ^{14}C [837] $NADPH_2$ system ^{14}C [843] rat ^{14}C [810, 811, 827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [803, 820, 829] persistent glucoside metabolites ^{14}C [830] foliage ^{14}C [804]	
X.11	4-benzothienyl-N-methylcarbamate benzo [b] thien-4-yl methylcarbamate	asulan MCA-600 Mobam® Mobil MC-A-600		Musca domestica ^{14}C [841] microsomes ^{14}C [841] alfalfa ^{14}C [831] barley ^{14}C [831]	

(1) cited officially in Bull. Ent. Soc. Am. 12: 1966, 357.

(2) as cited in various publications

X.12	3-isopropylphenyl methylcarbamate	UC 10854	carbonyl-labelled ^{14}C [827, 830]	Musca domestica albumin enhancement of oxidative metabolism ^{14}C [844] $NADPH_2$ system ^{14}C [843, 844] rat ^{14}C [827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [803, 829] persistent glucoside metabolites ^{14}C [830] foliage ^{14}C [804]	
X.13	3,5-diisopropylphenyl methylcarbamate	HRS-1422	carbonyl-labelled ^{14}C [827, 830]	Musca domestica $NADPH_2$ system ^{14}C [843] rat ^{14}C [827, 828] liver microsomes ^{14}C [839] bean plant ^{14}C [803, 829] persistent glucoside metabolites ^{14}C [830] foliage ^{14}C [804]	

Index Code	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residues
X.14	3,5-diisopropylphenyl N-methylcarbamate	DIP		Oncopeltus fasciatus uptake (e) ^{3}H [610]	
X.15	3,5-di-t-butylphenyl-N-methylcarbamate	Butacarb	^{3}H [809] ^{14}C [809] ^{3}H, ^{14}C [809]		sheep (meat, fat, kidney, liver) ^{3}H, ^{14}C [809]

5. INDEXES

5.1. INSECTICIDE INDEXES

5.1.1. Common and Manufacturers' Names Index

Insecticide	Category	Insecticide	Category
aldrin	C. 6	Dasanit	PC. 12
Alkron ®	PC. 2	DDT	D. 1
allethrin	B. 3	Delnav ®	PH. 2
allyl homologue of cinerin I	B. 3	derris	B. 1
amino carb	X. 3	diazinon	PH. 7
apholate	R. 1	Diazinon ®	PH. 7
aphoxide	R. 2	dichlorvos	PA. 3
arprocarb	X. 3	dihydrosafrole	A. 8
asulan	X. 11	dieldrin	C. 7
ASUNTOL ®	PH. 1	Dimecron ®	PA. 6
AZINPHOS-methyl	PH. 8	dimefox	PA. 13
azinphosmethyl	PH. 8	dimethoate	PA. 12
Azodrin ®	PA. 4	dimethrin	B. 4
Banol ®	X. 10	dimethyl sulfoxide	A. 5
Basudin	PH. 7	dimetilan	X. 6
Baygon ®	X. 1	Dimetilan ®	X. 6
BAYTEX ®	PC. 11	Dimetilane	X. 6
Bidrin ®	PA. 5	dioxathion	PH. 2
Birlane ®	PC. 18	Dipterex ®	PA. 1
Black Leaf 40 ®	B. 6	disulfoton	PA. 8
bromophos	PC. 9	Di-Syston ®	PA. 8
Butacarb	X. 15	dithiodemeton	PA. 8
Butocide	A. 1	Dowco ® 132	PC. 10
Butonate	PA. 11	139	X. 4
carbaryl	X. 5	179	PH. 5
carbon tetrachloride	F. 1	Dursban ®	PH. 5
chlordane	C. 3	Dylox ®	PA. 7
chlorfenvinphos	PC. 18	EPN	PC. 6
Chlorophenothene	D. 1	endosulfan	C. 9
chlorophos	PA. 1	endrin	C. 8
Chloropropylate ®	D. 3	ENTEX	PC. 11
Cela S-1942	PC. 9	ethion	PA. 13
Cidial ®	PC. 14	Etrolene ®	PC. 8
cinerin I	B. 2	Famophos	PC. 13
cinerin II	B. 2	famphur	PC. 13
Ciodrin ®	PC. 15	fenchlorphos	PC. 8
CO-RAL ®	PH. 1	fenitrothion	PC. 7
coumaphos	PH. 1	fenthion	PC. 11
cubé	B. 1	5-fluorouracil	R. 7
Cygon ®	PA. 12	Folithion ®	PC. 7
Cynem	PH. 6	FRUMIN AL ®	PA. 8

Insecticide	Category	Insecticide	Category
Furadan	X. 7	piperonyl butoxide	A. 1
gamma BHC	C. 2	Prolate ®	PH. 4
gammexane	C. 1	propoxur	X. 1
Gusathion ®	PH. 8	Pynamin	B. 3
Guthion ®	PH. 8	pyrethrin I	B. 2
Hanane	PA. 13	pyrethrin II	B. 2
hempa	R. 4	Resistox	PH. 1
heptachlor	C. 4	Rhothane ®	D. 2
Hercules AC-528	PH. 2	Rogor ®	PA. 12
Herkol	PA. 3	ronnel	PC. 8
Imidan ®	PH. 4	Ronnel ®	PC. 8
2-imidazolidinone	R. 6	rotenone powder and resins	B. 1
Isolan ®	X. 9	Roxion ®	PA. 12
Korlan ®	PC. 8	Ruelene ®	PC. 10
Lebaycid	PC. 11	safrole	A. 7
lindane	C. 2	Saphizon	PH. 9
malathion	PA. 9	Saphos ®	PH. 9
Malathon	PA. 9	sesamex	A. 3
Malix	C. 9	Sesoxane ®	A. 3
MATACIL ®	X. 3	Sevin ®	X. 5
Melipax	C. 5	Sok	X. 10
menazon	PH. 9	SOLVIREX ®	PA. 8
mercaptodimethur	X. 2	Stauffer R-1504	PH. 4
MESUROL ®	X. 2	Sulfox-Cide ®	A. 4
metaphoxide	PH. 10	sulfoxide	A. 4
methylenedioxyphenyl compounds	A. 6	sulfuryl fluoride	F. 4
2,3-methylenedioxynaphthalene	A. 10	Sumithion ®	PC. 7
methyl homologue of parathion	PC. 1	Sumitomo S-1102A	PC. 7
methyl parathion	PC. 1	synthetic pyrethrins	B. 3
Metron	PC. 1	TDE	D. 2
Mobam ®	X. 11	Telodrin	C. 10
Mobil MC-A-600	X. 11	Temik ®	X. 8
MUSCATOX ®	PH. 1	tepa	R. 2
myristicin	A. 9	TERRACUR-P ®	PC. 12
Nankor ®	PC. 8	Terra Sytam ®	PA. 13
Navadel	PH. 2	Thimet ®	PA. 7
Neguvon ®	PA. 1	Thiodan ®	C. 9
Nemafos ®	PH. 6	Thiodemeton	PA. 8
NEMAPHOS ®	PH. 6	THIOPHOS ®	PC. 2
Neo-pynamin	B. 5	thiotepa	R. 3
Nexion ®	PC. 9	TIGUVON	PC. 11
nicotine (sulfate)	B. 6	tinox	PA. 2
Niran ®	PC. 2	toxaphene	C. 5
Nitrox	PC. 1	trichlorfon	PA. 1
Octachlor ®	C. 3	Trichlorphon	PA. 1
Octa-Klor ®	C. 3	triphenyltin	R. 5
Octalene	C. 6	Trolene ®	PC. 8
Octalox	C. 7	Tropital	A. 2
PAPTHION ®	PC. 14	Tugon	PA. 1
Parathion	PC. 2	UNDEN ®	X. 1
PERFEKTION ®	PA. 12	Upjohn U-12927	X. 10
Pestox 14	PA. 13	vamidothion	PA. 10
Phenthoate	PC. 14	Vamidothion	PA. 10
phorate	PA. 7	Vamidoate	PA. 10
phosphamidon	PA. 6	Vapona ®	PA. 3
phthalthrin	B. 5	Velsicol 104 ®	C. 4

Insecticide	Category	Insecticide	Category
Velsicol 1068	C. 3	WARBEX ®	PC. 13
Vikane ®	F. 4	Zectran ®	X. 4
Viozene ®	PC. 8	ZINOPHOS ®	PH. 6

5.1.2. Letter and Number Index

Letter/Number		Chemical classification code
AC	3911	PA. 7
	12880	PA. 12
	18133	PH. 6
Am. Cyan.	3422	PC. 2
APO		R. 2
BAY	33051	PC. 14
Bayer	L13/59	PA. 1
	21/199	PH. 1
	9010	X. 1
	9017	PC. 20
	9026	X. 2
	9027	PH. 8
	17147	PH. 8
	19639	PA. 8
	25141	PC. 12
	29493	PC. 11
	39007	X. 1
	41831	PC. 7
	44646	X. 3
Bayer	E-600	PC. 5
	E-601	PC. 1
	E-605	PC. 2
	H-321	X. 2
BHC		C. 1
BIO-5462		C. 9
Black Leaf	40 ®	B. 6
Cela	S-1942	PC. 9
CL	38-23	PC. 13
Compound	118	C. 6
	269	C. 8
	497	C. 7
	4072	PC. 16
CP-14957		C. 10
DDE		D. 2
DDT		D. 1
DDVP		PA. 3
DIP		X. 14
DMF		PA. 13
Dowco	132 ®	PC. 10
	139 ®	X. 4
	179 ®	PH. 5
DOW	ET-14	PC. 8
	ET-57	PC. 8
E-3314		C. 4
ENT	17510	B. 3
	17957	PH. 1
	19763	PA. 4
	20852	PA. 11
	20871	A. 3
	21170	B. 4
	22897	PH. 2
	24650	PA. 12
	24915	R. 2
	24945	PC. 12
	25540	PC. 11
	25726	X. 2
	25766	X. 4
	25784	X. 3
	26316	R. 1
	27093	X. 8
	27164	X. 7
	27339	B. 5
	27386	PC. 14
	50382	R. 4
EPN		PC. 6
EPN-300		PC. 6
G	23611	X. 9
	24163	D. 3
	-24480	PH. 7

Letter/Number	Chemical classification code
GS -13005	PH. 3
-13332	X. 6
gamma BHC	C. 2
HCH	C. 1
HEOD	C. 7
Hercules AC-528	PH. 2
HHDN	C. 6
HMPA	R. 4
Hoe 2671	C. 9
HRS-1422	X. 13
L 11/6	PA. 7
561	PC. 14
MCA-600	X. 11
ML-97	PA. 6
Mobil MC-A-600	X. 11
NC-262	PA. 12
NIA 10242	X. 7
Niagara 5462	C. 9
OM 2174	R. 1
OR-1191	PA. 6
PP 175	PH. 9
Prestox 14	PA. 13
R-1504	PH. 4
RP-9895	PA. 10
—	
S 1752	PC. 11
-1942	PC. 9
SD 3562	PA. 5
-4294	PC. 15
4402	C. 10
-7859	PC. 16
8447	PC. 17
9129	PA. 4
SP-1103	B. 5
SQ 8388	R. 1
Stauffer R-1504	PH. 4
Sumitomo S-1102A	PC. 7
TDE	D. 2
UC 10854	X. 12
21149	X. 8
Upjohn U-12927	X. 10
Velsicol 104 ®	C. 4
Velsicol 1068	C. 3
17/147	PH. 8
666	C. 1
1068	C. 3
3956	C. 5
4049	PA. 9
7744	X. 5

5.2. AUTHOR INDEX

5.2.1. Corporate Author Index

The Author is single or first author where references are underlined.

Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.: 496, 509

California Univ., Los Angeles Lab. of Nuclear Medicine and Radiation Biology: 511

European Atomic Energy Community: 908

Food and Agricultural Organization of the United Nations, Rome (Italy): 1537, 1791

International Atomic Energy Agency, Vienna (Austria): 559, 577, 739, 1325, 1537, 1562, 1594, 1595, 1596, 1597, 1760, 1791, 1792, 1798

International Lab. of Genetics and Biophysics, Naples (Italy): 289

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442

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5.3. SUBJECT INDEX

The reader is advised to familiarize himself with the convention used in order to extract the maximum information from the Subject Index. A notation has been adopted which conveys condensed information at a glance: the position of a radioisotope or radiation, and the symbols (/) and (,) have a special significance.

When the radioisotopes or radiations represent the cause, they precede the phenomenon reported; when used as a tool for analysing existing conditions, they follow the phenomenon studied. Combinations or comparisons of different experimental factors are indicated by linking them by the symbol (/) or (,), respectively.

The system is illustrated below, with examples drawn from the Bibliography itself.

Radioisotope	Radiation
^{32}P: growth and development: 25 (effects of ^{32}P on growth and development)	γ: ovary: 1335 (effects of γ-irradiation on organ studied) γ: behaviour (avoidance reaction): 1466 ("avoidance reaction" caused by γ-irradiation)
	x/O: life span: 1454 ("/... = additional experimental factor introduced before, during or after original treatment, in this case x-irradiation) x, chemosterilant: sterility: 1268 (", ... = comparison between effects of different treatments)
Calligypona pellucida, migration, ^{32}P: 504 (migration is traced [not affected] by ^{32}P) carbohydrate biosynthesis, ^{3}H: 147 (biosynthesis is traced by ^{3}H)	Sitotroga cerealella (ℓ, p), development in corn kernels, x : 1705-6 (development traced [not affected] by x-rays)

Differential irradiation of the sexes, with or without mating, is indicated as in the following example:

x: ♀	x-irradiation of female, stage not specified
♀-	irradiation of female, followed by mating
♂-	irradiation of male, followed by mating
♀(♂)	irradiation of inseminated female
♀,♂	irradiation of both sexes
♀-♂	irradiation of both sexes, followed by mating
p, ♀	irradiation of female pupa

Life stages or tissues relevant to a particular animal study are indicated in brackets, whenever possible. A Glossary of the abbreviations used is given on page XV. The following symbols have also been used:

IV Roman numbers in connection with genetic effects indicate "chromosome, number IV".

QQ.2 After scientific name of insect: systematic code, referring to appropriate position in Table 1.

[PA.3] After chemical compound: insecticide code, referring to appropriate position in Table 2.

Usually, entries under any one heading in the Subject Index are listed alphabetically. Where the entries are particularly numerous, however, they tend to be listed alphabetically in groups: according to insects – animals other than insects – plants – and miscellaneous.

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* See also section 1.2.6.

** Due to the bulk of pertinent references, these have not been summarized here; the use of ^{3}H is, however, indicated for each relevant study throughout the subject index.

* See also under individual species of social insects.

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6. APPENDIX

6.1. INSECT CONTROL BY RADIATION (not necessarily ionizing)

(Some selected references)

6.1.1. Electromagnetic and Sonic Energy

APX1 Dyck, W. van LA DESTRUCTION D'INSECTES DANS LE BOIS PAR IRRADIATION DIRECTE AVEC DES ONDES DECIMETRIQUES. (Destruction of insects in wood by direct irradiation with decimetric waves.) Revue Agric., Brux. 18, 7/8 (1965) 901-904.

La fréquence utilisée était 2425 MHz (longueur d'onde ~ 12,5 cm) et le chauffage ne se produit pas entre deux électrodes auxquelles on applique la tension à haute fréquence, mais par irradiation directe. Il a fallu se limiter à 120 watts de l'émetteur. Les insectes étaient en pleine activité au moment du traitement. Leur présence se traduisait par le rejet continu de vermoulure. Ce témoignage d'activité a cessé immédiatement dans le bois traité. Il ne s'était pas encore renouvelé après 8 mois alors que de nouvelles manifestations d'attaques sont perceptibles dans le même immeuble sur le bois non traité. Les résultats constatés sont encourageants. Le traitement n'exclut pas toutefois la réinfestation des boiseries.

APX2 Kadoum,* A.M., Ball, H.J., Nelson, S.O. MORPHOLOGICAL ABNORMALITIES RESULTING FROM RADIOFREQUENCY TREATMENT OF LARVAE OF Tenebrio molitor. Ann.ent.Soc.Am. 60 (1967) 889-892.

T.molitor larvae were exposed to two different RF intensities at a frequency of 39 MHz. With the electrodes in contact with the top and bottom of the polystyrene holder, an electrode voltage of 3.6 kV was used for one experiment, and 0.9 kV was used for another. Adults developing from larvae exposed at sublethal levels exhibited malformed and missing legs. The number of imaginal legs was reduced as exposure time increased. The degree of leg malformation increased when treatment was administered again during the 6th instar. Similar treatments of 5th-instar larvae did not interfere with normal imaginal leg development. Deformities most likely resulted from heat damage to the histoblasts that project into the legs of the 6th or least-instar larvae. (NSA 22:1968, 10847)

* For full initials, see APX3.

APX3 Kadoum, A.M.A.A.G. EFFECTS OF RADIO-FREQUENCY ELECTRICAL FIELDS ON THE METABOLISM OF THE YELLOW MEALWORM, Tenebrio molitor (L.). Diss.Abstr. 27B, 8 (1967) 2553.

The purpose of this research was to explore some of the biochemical changes initiated in T.molitor (L.) larvae by exposure to radio-frequency electric fields. T. molitor (L.) larvae were exposed to both continuous and pulse-modulated RF electric fields. Continuous exposures were conducted at a frequency of 39 mCi using 3.5 kV for 5.5 sec, whereas the pulse-modulated treatments were made at the same frequency at an energy level of 6.0 kV at the rate of 20 pps using a pulse width of 5 ms respectively. RF treated larvae lost significantly more weight than the starved and control larvae during the 5 d following RF exposure. The respiratory rates of RF treated larvae were significantly higher than the rates for the control insects. This increase in oxygen consumption in RF treated larvae persisted throughout the 4th day following RF treatment. The rate of incorporation of labelled amino acids into soluble protein was higher in RF treated insects as compared to control insects. An increase in $^{14}CO_2$ expired following injection of labelled amino acids was noticed in RF treated larvae during the

24-h period following treatment. T. molitor (L.) larvae tended to void excess amino acids injected into the haemocoel. The results of this work indicated that a mechanism other than general internal heating might be responsible for the death of irradiated insects. Death, it was concluded, could result from a change in the normal metabolic activity of irradiated insects as well as physical change in the waxy layer of the epicuticle. (From DA)

APX4 Nelson, S.O. ELECTROMAGNETIC AND SONIC ENERGY FOR INSECT CONTROL. Trans Am. Soc. agric. Engrs 9 (1966) 398-403.

Past accomplishments, current studies, and future possibilities for insect control using electromagnetic, sonic, and ultrasonic energy are reviewed. References (134) are included. (NSA 21:1967, 34748)

APX5 See 1771 Pest control by physical means. (Carleton, W.M. et al., 1966)
1783 New ways to control insects. (Nelson, S.O., 1966)
1789 Physical methods of insect control. (Watters, F.L., 1965)

APX6 See 1784 Electromagnetic energy. (Nelson, S.O., 1967)
1475 The responses of Drosophila melanogaster to weak electromagnetic fields. (Picton, H.D., 1964)

APX7 Vilenchik, M.M. EFFETS MAGNETIQUES EN BIOLOGIE. Usp. sovrem. Biol. 63, 1 (1967) 54-72. (In Russian)

A review paper dealing with the question whether the constant magnetic field represents a biologically active factor. The problems covered are (1) orientation effects, (2) disturbances in the reflex activity of animals in the magnetic field, (3) magnetotropisms, (4) functional-morphological disturbances observed in animals exposed to prolonged action of the magnetic field, (5) changes of radiation effects due to the magnetic field, (6) inhibition in the growth of tumours by the magnetic field, (7) and any genetic effects of the magnetic field. The great variety of biological objects discussed included some insects: Drosophila melanogaster [under (1) and (7),] and termites, flies, grasshoppers, and cockchafers [under (1)].

6.1.2. Lasers

APX8 Wilde, W.H.A. LASER EFFECTS ON TWO INSECTS. Can. Ent. 97, 1 (1965) 88-92.

The effects of a laser of 1.5 mm diameter were studied on Trogoderma versicolor and Periplaneta americana. The damage and mortality observed are described.

APX9 Wilde, W.H.A. LASER EFFECTS ON SOME PHYTOPHAGOUS ANTHROPODS AND THEIR HOSTS. Ann. ent. Soc. Am. 60 (1967) 204-207.

Low-energy ruby laser pulses of 0.6 J/msec^2 produced degrees of damage relative to the coloured pigmentation of certain arthropods and their plant hosts; the darker the pigmentation, the more severe the damage. Structural shape and microdistance between arthropod life stages and host surfaces were other factors affecting the degree of laser damage. Rounded surfaces reflected laser pulses more than did elliptical or flat surfaces, even when colouration was similar. Microdistances appeared to serve as insulation against residual or reflected heat from lasered host-plant areas. Two species of mites, Panonychus ulmi and Tetranychus urticae; the greenhouse white fly, Trialeurodes vaporariorum; the green peach aphid, Myzus persicae; and the pear psylla, Psylla pyricola, were used as test arthropods. The host plants were pear seedlings, alfalfa, and rye grass (Bromus sp.). (NSA 21:1967, 22760)

6.1.3. Booby Traps

APX10 Whitten, M.J., Norris, K.R. "BOOBY-TRAPPING" AS AN ALTERNATIVE TO STERILE MALES FOR INSECT CONTROL. Nature, Lond. 216 (1967) 1136.

A system is proposed in which a resistant strain, available in the field or developed in the laboratory, might be used against a susceptible strain in the field. Some experiments have already been carried

out with the Australian sheep blowfly, Lucilia cuprina. Dieldrin-resistant females (which survived 0.5 µl of 2% dieldrin applied topically to the thorax) were exposed to a susceptible strain (LD 50 < 0.005% dieldrin). Each female killed up to 100 males through contact during attempted matings. The male was less effective. – Resistant insects thus require mass rearing, sterilization, loading with the appropriate insecticide and release among susceptible populations. Another possibility is to load insects with a non-lethal topical dose of a stable chemosterilant of a type to have a sterilizing effect on the carrier and on would-be mates. A low natural density would be necessary; the adult stage should not be attracted to humans, if highly toxic insecticides are employed; behavioural characteristics should be such as to lead to frequent bodily contact between individuals. L. cuprina would fulfil these conditions.

6.2. INSECT REARING

6.2.1. Survey*

APX11 Smith, C.N. INSECT COLONIZATION AND MASS PRODUCTION. "Insect Colonization and Mass Production". Smith, C.N., Ed. New York, Academic Press. 1966, 618 p.

Recent developments in entomological research have augmented the importance of insect colonies to basic research and practical control. Control methods now in use, or foreseen for the future, such as the release of sterile males, the extensive distribution of insect pathogens, the practical use of pheromones, and the genetic manipulation of natural populations, will require the production of millions of insects per week for the control of certain economically important species. An attempt has been made to bring together the most recent information on method of rearing representative species, with emphasis on the general principles of nutrition and management that can be applied to the colonization of other species as well. Chapters are largely self-contained. Some are concerned with only a single species, selected to stand as an example of its taxonomic group, and to a lesser extent of other insects with similar nutritional and environmental requirements. Other chapters discuss rearing methods for entire groups of species that share common requirements. Extensive bibliographical material is given at the end of each chapter.

* See Table 3.

TABLE 3. SOME INSECT AND RELATED ARTHROPOD PESTS: GUIDE TO COLONIZATION AND MASS REARING *

INSECT Common Name	Scientific Name	Systematic Code	Order	Family	Class	Author(s)	Affiliation
ANIMAL PARASITES AND HAEMATOPHAGOUS ARTHROPODS							
body louse	Pediculus humanus humanus L.	O. 4	Anoplura	Pediculidae	Insecta	Cole, M. M.	Entomology Research Division, ARS, USDA, Gainesville, Fla., USA
parasitic mites							
dermanyssid mites		Ac. 4	Acarina (Mesostigmata)	Dermanyssidae Macronyssidae Haemogamasinae Laelapinae	Arachnida	Audy, J. R. Lavoipierre, M. M. J.	The George Williams Hooper Foundation, University of California Medical Center, San Francisco, Calif., USA
chigger mites		Ac. 15	Acarina (Trombidiformes)	Trombiculidae			
itch mites		Ac. 11	Acarina (Sarcoptiformes)	Sarcoptidae			
scab mites		Ac. 9		Psoroptidae			
ticks	Argas	Ac. 2	Acarina	Argasidae	Arachnida	Gregson, J. D.	Research Station, Canada Department of Agriculture, Kamloops, British Columbia, Canada
	Rhipicephalus secundus Feldman-Muhsam	Ac. 8		Ixodidae			
	Amblyomma						
southern cattle tick	Boophilus microplus (Canestrini)						
American dog tick	Dermacentor variabilis (Say)						
	Hyalomma						
	Ixodes						
	Ornithodoros	Ac. 2		Argasidae			

* See reference APX. 11.

INSECT		Systematic Code	Order	Family	Class	Author(s)	Affiliation
Common Name	Scientific Name						
rat flea	Xenopsylla cheopis (Rothsch.)	Y. 2	Syphonaptera	Pulicidae	Insecta	Krishnamurthy, B. S.	National Institute of Communicable Diseases, Delhi, India
common malaria mosquito	Anopheles quadrimaculatus Say	X. 11	Diptera	Culicidae	Insecta	Gahan, J. B.	Entomology Research Division, ARS, USDA, Gainesville, Fla., USA
mosquito	Culex pipiens fatigans Wied.	X. 11	Diptera	Culicidae	Insecta	de Meillon, B. Thomas, V.	Army Mosquito Project, Smithsonian Institute, U. S. National Museum, Washington, D. C., USA. College of Agriculture, Serdang-Selangor, Sungei Besi, P. O. Malaysia
biting midges	Culicoides	X. 7	Diptera	Ceratopogonidae	Insecta	Jones, R. H.	Entomology Research Division, ARS, USDA, Denver, Colo., USA
black flies	Simulium	X. 30	Diptera	Simuliidae	Insecta	Muirhead-Thomson, R. C.	Division of Communicable Diseases, WHO, Geneva, Switzerland
stable flies	Stomoxys calcitrans (L.)	X. 19	Diptera	Muscidae	Insecta	Jones, C. M.	Insectary, University of Nebraska, Lincoln, Nebr., USA
tsetse flies	Glossina morsitans Westwood Glossina spp.	X. 19	Diptera	Muscidae	Insecta	Lumsden, W. H. R. Saunders, D. S.	Trypanosomiasis Research Unit, Department of Animal Health, Royal (Dick) School of Veterinary Studies, University of Edinburgh, Easter Bush, Roslin, Midlothian, Edinburgh, Scotland Department of Zoology, University of Edinburgh, Easter Bush, Roslin, Midlothian, Edinburgh, Scotland
bed bugs	Cimex lectularius Linnaeus Cimex hemipterus Fabricius	Q. 5	Heteroptera	Cimicidae	Insecta	Burden, G. S.	Entomology Research Division, ARS, USDA, Gainesville, Fla., USA

INSECT Common Name	INSECT Scientific Name	Systematic Code	Order	Family	Class	Author(s)	Affiliation
reduviid bugs	Reduvius Triatoma	Q. 18	Heteroptera	Reduviidae Triatominae	Insecta	Ryckman, R. E. Ryckman, A. E.	Department of Microbiology, School of Medicine, Graduate School, Loma Linda University, Loma Linda, Calif., USA
DOMESTIC AND STORED PRODUCT INSECTS							
houseflies	Musca domestica L.	X. 19	Diptera	Muscidae	Insecta	Spiller, D.	Plant Diseases Division, Department of Scientific and Industrial Research, Auckland, New Zealand
cockroaches	Blattella germanica (L.) Periplaneta americana (L.)	H. 2	Orthoptera	Blattidae	Insecta	Smittle, B. J.	Entomology Research Division, ARS, USDA, Gainesville, Fla., USA
granary weevil rice weevil corn weevil	Sitophilus granarius (L.) Sitophilus oryzae (L.) Sitophilus zeamais (Mots.)	V. 19	Coleoptera	Curculionidae	Insecta	Harein, P. K. Soderstrom, E. L.	Department of Entomology, Fisheries, and Wildlife, University of Minnesota, St. Paul, Minn., USA. Stored-Products Insects Research and Development Laboratory, USDA, Savannah, Ga., USA
cadelle	Tenebroides mauritanicus (L.)	V. 46		Tenebrionidae			
red flour beetle confused flour beetle	Tribolium castaneum (Hbst) Tribolium confusum Duv.						
almond moth Mediterranean flour moth	Cadra cautella (Wlk.) Anagasta kühniella Z.	U. 36	Lepidoptera	Phycitidae	Insecta	Boles, H. P.	Mid-West Grain Insects Investigations, Stored-Products Insects Branch, Marked Quality Research Division, ARS, USDA, Manhattan, Kans., USA. Stored-Products Insects Research and Development Laboratory, Savannah, Ga., USA
Indian meal-moth	Plodia interpunctella (Hbn.)	U. 41		Pyralidae		Mariske, F. O.	

INSECT Common Name	Scientific Name	Systematic Code	Order	Family	Class	Author(s)	Affiliation
PHYTOPHAGOUS INSECTS (DIETS)							
boll weevil	Anthonomus grandis Boh.	V. 19	Coleoptera	Curculionidae	Insecta	Vanderzant, E. S.	Entomology Research Division, ARS, USDA, Texas A&M University, College Station, Tex., USA
European corn borer	Pyrausta nubilalis (Hbn.)	U. 41	Lepidoptera	Pyralidae			
green peach aphid	Myzus persicae (Sulzer)	QQ. 2	Hemiptera (Homoptera)	Aphididae			
milkweed bug	Oncopeltus fasciatus (Dall.)	Q. 10	Hemiptera (Heteroptera)	Lygaeidae			
onion maggot	Hylemya antiqua Meigen	X. 18	Diptera	Anthomyiidae			
oriental fruit moth	Grapholitha molesta (Busck)	U. 33	Lepidoptera	Olethreutidae			
pink bollworm	Pectinophora gossypiella (Saund.)	U. 13	Lepidoptera	Gelechiidae			
rice stem borer	Chilo suppressalis (Wlk.)	U. 8	Lepidoptera	Crambidae			
silkworm	Bombyx mori (L.)	U. 3	Lepidoptera	Bombycidae			
southern pine beetle	Dendroctonus frontalis Zimm.	V. 42	Coleoptera	Scolytidae	Insecta	Clark, E. W.	U. S. Forest Service, Forestry Sciences Laboratory, Durham, N. C., USA.
coarse writing engraver	Ips calligraphus Germ.					Osgood, E. A., Jr.	Department of Entomology, University of Maine, Orono, Maine, USA
greater elm bark beetle	Scolytus multistriatus Marsh						
lesser elm bark beetle	Hylurgopinus rufipes Eich						

INSECT Common Name	INSECT Scientific Name	Systematic Code	Order	Family	Class	Author(s)	Affiliation
grasshoppers Egyptian - two-striped - migratory - locust African migratory - red - desert -	Anacridium aegyptium L. Melanoplus bivittatus (Say) Melanoplus sanguinipes (Fabricius) Locusta migratorioides R&F Nomadacris septemfasciata Say Schistocerca gregaria Forsk.	H,I	Orthoptera	Acrididae	Insecta	Cowan, F.T.	Entomology Research Division, ARS, USDA, Bozeman, Mont., USA
European corn borer	Ostrinia nubilalis (Hbn.)	U.42	Lepidoptera	Pyraustidae	Insecta	Raun, E.S.	Corn Borer Laborstory, ARS, USDA, Ankeny, Iowa, USA
codling moth	Carpocapsa pomonella (L.)	U.33	Lepidoptera	Olethreutidae	Insecta	Hamilton, D.W. Hathaway, D.O.	Japanese Beetle Investigations, Entomology Research Division, ARS, USDA, Moorestown, N.J., USA. Entomology Research Division, ARS, USDA, Yakima, Wash., USA
pink bollworm	Pectinophora gossypiella (Saund.)	U.13	Lepidoptera	Gelechiidae	Insecta	Martin, D.F.	Cotton Insect Research Branch, Entomology Research Division, ARS, USDA, Beltsville, Md., USA
corn rootworms northern - western - southern -	Diabrotica spp. D. longicornis (Say) D. virgifera Lec. D. undecimpunctata howardi Barber	V,13	Coleoptera	Chrysomelidae	Insecta	Howe, W.L., George, B.W.	Northern Grain Insects Research Laboratory, Entomology Research Division, ARS, USDA, Brookings, S. Dak., USA

INSECT		Systematic Code	Order	Family	Class	Author(s)	Affiliation
Common Name	Scientific Name						
false wireworms	Eleodes spp. Eleodes suturalis	V. 46	Coleoptera	Tenebrionidae	Insecta	Matteson, J. W.	Monsanto Company, Agricultural Division, Insecticide Chemicals Development Department, St. Louis, Miss., USA
peach tree borer	Sanninoidea exitiosa (Say)	U. 1	Lepidoptera	Aegeriidae	Insecta	Smith, E. H.	Department of Entomology, North Carolina State University, Raleigh, N. C., USA
boll weevil	Anthonomus grandis Boh.	V. 19	Coleoptera	Curculionidae	Insecta	Gast, R. T. Davich, T. B.	Boll Weevil Research Laboratory, Entomology Research Division, ARS, USDA, State College, Miss., USA
wheat stem sawfly	Cephus cinctus Nort.	W. 6	Hymenoptera	Cephidae	Insecta	Wallace, L. E.	Wheat Stem Sawfly Investigations, ARS, USDA, Bozeman, Mont., USA
Lygus bugs	Lygus hesperus Knight L. lineolaris (P. de B.) L. elisus Vanduzee	Q. 11	Hemiptera (Heteroptera)	Myridae	Insecta	Bottger, G. T.	Entomology Research Division, ARS, USDA, Tucson, Ariz., USA
aphids		QQ. 2	Hemiptera (Homoptera)	Aphididae	Insecta	Harries, F. H.	Tree Fruit Research Center, Wenatchee, Wash., USA
bean aphid	Aphis fabae Scop.						
potato aphid	Macrosiphum euphorbiae (Thomas)						
pea aphid	Acyrthosiphon pisum (Harris)						
green peach aphid	Myzus persicae (Sulzer)						
greenbug	Schizaphis graminum (Rondani)						

INSECT Common Name	Scientific Name	Systematic Code	Order	Family	Class	Author(s)	Affiliation
woolly apple aphid	Eriosoma lanigerum (Hausmann)	QQ. 2					
chrysanthemum aphid	Macrosiphoniella sanborni (Gill.)						
spotted alfalfa aphid	Therioaphis maculata (Buckton)						
green two-spotted spider mite	Tetranychus urticae (Koch)	Ac. 14	Acarina	Tetranychidae	Insecta	Jacklin, S. W. Smith, F. F.	Entomology Research Division, ARS, USDA, Beltsville, Md., USA
coneworms	Dioryctria abietella (D. & S.) Dioryctria amatella Hulst	U. 36	Lepidoptera	Phycitidae	Insecta	Merkel, E. P. Fatzinger, C. W.	Southeastern Forest Experiment Station, Forest Service, USDA, Olustee, Fla., USA
cabbage loopers	Trichoplusia ni (Hbn.)	U. 29	Lepidoptera	Noctuidae	Insecta	Henneberry, T. J. Kishaba, A. N.	Entomology Research Division, ARS, USDA, Riverside, Calif., USA
tobacco hornworm tomato hornworm	Protoparce (Manduca) sexta (Johan.) Manduca quinquemaculata (Haworth)	U. 46	Lepidoptera	Sphingidae	Insecta	Hoffman, J. D. Lawson, F. R. Yamamoto, R.	Entomology Research Division, ARS, USDA, Oxford, N.C., USA. Entomology Research Division, ARS, USDA, Colombia, Miss., USA. Department of Entomology, North Carolina State University, Raleigh, N. C., USA
MASS REARING OF INSECTS IN TERMS OF MILLIONS							
screw-worm	Cochliomyia hominivorax (Coq.)	X. 5	Diptera	Calliphoridae	Insecta	Baumhover, A. H. Human, C. N. Graham, A. J.	Entomology Research Division, USDA, Oxford, N. C., USA. Administrative Services, USDA, Beltsville, Md., USA. Animal Health Division, USDA, Mission, Tex., USA

INSECT		Systematic Code	Order	Family	Class	Author(s)	Affiliation
Common Name	Scientific Name						
fruit flies		X.35	Diptera	Tephritidae	Insecta	Steiner, L. F. Mitchell, S.	Entomology Research Division, ARS, USDA, Honolulu, Hawaii, USA
Mediterranean –	Ceratitis capitata (Wied.)						
oriental –	Dacus dorsalis Hendel						
olive –	Dacus oleae (Gmel.)						
Queensland –	Dacus tryoni (Froggat)						
melon fly	Dacus cucurbitae Coq.						
yellow fever mosquito	Aedes aegypti (L.)	X.11	Diptera	Culicidae	Insecta	Morlan, H. B.	Aedes aegypti Eradication Branch, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education and Welfare, Atlanta, Ga., USA

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