tient as the radiation, and defined by the diaphragm system just as the γ-ray beam is.

Measurements were carried out by the group in Ottawa and by the group in Saskatoon. Depth dose measurements were made and isodose distributions determined for a variety of field sizes and source-to-skin distances. The results obtained by the two groups are in excellent agreement. A description of the methods and the details of the results will be published elsewhere (*1*). A summary of the results is given in Table 1 in which cobalt radiation is compared with that obtainable from a 2-mev Van de Graaff generator (*3*). In the first two columns, results are for a 5 cm × 5 cm field at an SSD of 100 cm, and in the last two columns results are given for a 10 cm × 10 cm field. In both cases the percentage depth dose obtainable with the cobalt is considerably greater than that reported for the 2-mev x-ray machine. In fact, the distributions of radiation are more nearly comparable with 3-mev x-rays (*4*).

The units should require less service and be more flexible in use than x-ray machines. The cobalt offers an alternative to x-ray machines in the 2–4-mev range.

References

1. *Brit. J. Radiology* (in press).
2. DIXON, W. R., FISH, F. H., and MORRISON, A. *J. Can. Assoc. Radiologists*, **2**, 12 (1951).
3. TRUMP, J. G., *et al. Am. J. Roentgenol. Radium Therapy*, **57**, 703 (1947).
4. TRUMP, J. G., and CLOUD, R. W. *Ibid.*, **49**, 531 (1943).

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Absorption of DDT in Houseflies over an Extended Period[1]

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Studies on absorption of DDT by houseflies (*Musca domestica* L.) are usually based on an analysis of the extract of the flies 24 or 48 hr after treatment of the insect. Sternburg and Kearns (*1*), Perry and Hoskins (*2*), and Lindquist *et al.* (*3*) have reported on results obtained on this basis. Recent work in this laboratory has shown that the timing of the analyses in experiments of this type is very important. Considerable differences in the external and internal distribution of DDT may result if attention is not paid to this point.

In studies on absorption the writers radioassayed Orlando resistant flies that had been treated individually with acetone solutions of radioactive DDT about one year previously. Each fly had received 15 μg of DDT on the thorax, and the flies had been stored in pillboxes in the laboratory. They were prepared for radioassay by relaxing them in a high-humidity chamber and rinsing them in 5 ml of acetone for 30 sec to remove the DDT on the exterior of the body. The flies or dissected parts were then macerated in the presence of acetone. When the material was dry, the radioactivity was determined in a windowless gas-flow counter attached to a scaler. Measured amounts of the insecticide solution applied to counting plates with a microsyringe showed that 1 μg of DDT produced 165–180 cpm with this equipment. These figures were used in computing the micrograms of DDT or metabolites found in the extracts of the fly tissues.

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TABLE 1

DISTRIBUTION OF DDT OR DDT METABOLITES IN FLIES 385 DAYS AFTER DEATH. ONE μG RADIOACTIVE DDT WAS EQUIVALENT TO 165 CPM

Dissected parts	DDT or metabolite absorbed per fly	
	μg	Percentage of total
Internal organs, muscle, body fluids, gut, etc.	3.50	53
Cuticle-hypoderm:		
Top of thorax	0.56	9
Abdominal	.68	10
Remainder of thorax, legs, and wings	1.15	18
Entire head	0.64	10
Total	6.53	100

Radioactivity measurements indicated that an average of 5.8 μg DDT/fly had penetrated the integument of the flies surviving the DDT application, and that 3.3 μg remained on the exterior. Similarly, flies succumbing to the applied DDT showed a penetration of 7.5 μg each and a surface retention of 3.3 μg. This is in marked contrast to the 2.0 or 2.6 μg absorbed when the radioassay was performed 24–48 hr after the flies were treated (*3*).

In order to determine the morphological distribution of the DDT or metabolites, 10 of the flies were dissected. Table 1 shows that 3.50 μg of DDT or metabolites were in the internal organs. Previously, Lindquist, Roth, Hoffman, and Butts (*4*) made dissections of flies 24–48 hr after treatment and found an average of 0.271 μg, or 26–34% of the amount absorbed, in the internal organs; the remainder was in the cuticle-

TABLE 2

ABSORPTION OF DDT OR DDT METABOLITES IN FLIES AT INTERVALS AFTER TREATMENT (5.9 μG RADIOACTIVE DDT APPLIED PER FLY). ONE μG WAS EQUIVALENT TO 180 CPM

Days after treatment	Surviving flies		Dead flies	
	External wash (μg)	Extract of fly (μg)	External wash (μg)	Extract of fly (μg)
1	3.8	0.39	4.5	0.41
5	2.9	.71	3.9	.74
7	2.2	.88		
9	1.5	1.26	2.9	1.09

TABLE 3

AMOUNTS OF DDT OR DDT METABOLITES PRESENT IN VARIOUS PARTS OF FLIES SURVIVING AN 11.25 μG DOSAGE OF RADIOACTIVE DDT (6 TO 10 FLIES EXAMINED ON EACH DATE). ONE μG WAS EQUIVALENT TO 180 CPM

Dissected parts	After 2 days		After 6 days		After 10 days	
	μg	Percentage of total	μg	Percentage of total	μg	Percentage of total
Body fluids	—	—	0.23	9.7	0.30	9.6
Reproductive system	0.24	20.2	.33	13.8	.50	17.4
Intestinal tract	.03	2.8	.12	5.0	.10	3.3
Thoracic ganglion	.05	4.3	.12	5.2	.07	2.4
Thoracic muscle	.04	3.8	.14	6.1	.16	5.2
Abdominal and thoracic cuticle-hypoderm	.44	37.0	.70	29.6	1.03	34.3
Wings, legs, head	.38	31.9	.72	30.6	.84	27.8
Total	1.19	100.0	2.36	100.0	3.00	100.0

hypoderm. Sternburg and Kearns (*1*) found by chemical analysis that very little, if any, DDT or DDE (1,1,dichloro-2,2-bis(*p*-chlorophenyl) ethylene) was present in the interior parts of resistant houseflies treated with DDT. The penetration and distribution of DDT in flies over a long period of time appear to be physical phenomena. Richards and Cutkomps (*5*) showed that cuticle and purified chitin absorbed part or all of the DDT when placed in moderately dilute suspensions of DDT in distilled water.

In order to obtain information on the rate of absorption over a period of several days, Orlando resistant flies were treated on the thorax with 5.9 μg radioactive DDT/fly and held at room temperature (60°–75° F). In 24 hr the mortality was 25%. From 6 to 10 survivors were killed at intervals, and a radioassay was made of the amount of DDT absorbed. Table 2 shows that the amount absorbed increased from 0.39 μg after 1 day to 1.26 μg after 9 days. The flies that died within 24 hr showed a similar trend.

The increase in amount of DDT absorbed suggested further tests to determine whether the absorbed radioactive DDT was concentrated in certain organs. Flies were treated with 11.25 μg DDT each, and the mortality was 54% in 24 hr. As shown in Table 3, the total internal radioactivity of these flies increased with time, up to 10 days, but the morphological distribution did not change. From 31 to 40% of the total DDT applied was found in the internal systems, and the remainder was in the cuticle. The amount absorbed per fly was considerably greater than that resulting from treatments with 5.9 μg (Table 2). This is in agreement with the results of Sternburg *et al.* (*1*), who had shown that absorption of DDT was greater with larger applications.

These experiments demonstrate the importance of timing the analysis of flies in DDT-absorption studies. A 5-day delay in the analysis of flies succumbing within 24 hr after treatment increased the amount of DDT absorbed as much as 45%, and 9-day delay 62%. About the same increase was obtained for flies that survived the DDT treatment for 5 days, indicating that absorption of DDT proceeds at about the same rate in dead as in living flies. Treated flies radioassayed after a lapse of more than a year showed a large increase in the amount of DDT penetrating the integument.

References

1. STERNBURG, J., and KEARNS, C. W. *Ann. Entomol. Soc. Am.*, **43**, (3), 444 (1950).
2. PERRY, A. S., and HOSKINS, W. M. *Science*, **111**, 600 (1950).
3. LINDQUIST, A. W., *et al. J. Econ. Entomol.*, **44**, 167 (1951).
4. *Ibid.* (in press).
5. RICHARDS, A. G., and CUTKOMPS, L. K. *Biol. Bull.*, **90**, 97 (1946).

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The Accumulation of Serum Cholate and its Relationship to Hypercholesteremia[1]

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Hypercholesteremia can be produced in the rat by such different procedures as (1) ligation of the bile duct (*1, 2*); (2) production of experimental nephrosis (*3*); and (3) injection of Triton W 1339 (*6*). Recently we have obtained evidence (*4–6*) which indicates that each of these procedures also induces a rise in the cholate content of the animal's blood. It is the accumulation, moreover, of this latter steroid that appears responsible for the ensuing hypercholesteremia observed in the above conditions. In other words, the rise in cholesterol content of plasma seems to be a phenomenon *secondary* to the "hypercholatemia" effected by these particular procedures. The mechanism, however, by which excess accumulation of cholate in blood induces hypercholesteremia is still to be determined.

In view of the above findings concerning the primacy of cholate accumulation in the pathogenesis of

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