CHLORINATED HYDROCARBONS DEPOSITED IN BIOLOGICAL MATERIAL [1]

II. ANIMAL AND ANIMAL PRODUCTS

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MILK

Extensive studies have been reported on residues of chlorinated hydrocarbons in milk after dairy cows or barns were sprayed with insecticides *(66)* or after cows ingested insecticide contaminated feed *(67)*. Spraying cows and/or barns with DDT resulted in milk residues of 0.3 to 33.6 ppm. Highest levels were generally encountered shortly after spraying. In some instances DDT persisted in milk for 119 and 126 days after cows had received their last spray treatment. Milk from cows sprayed with methoxychlor contained from 0.13 to 0.4 ppm initially. Residues of this insecticide disappeared from milk quite rapidly. Data obtained for other chlorinated hydrocarbons used as sprays were similar to those just discussed.

Claborn, *et al. (13)* sprayed dairy cows with different insecticides and periodically examined milk from these cows for presence of insecticides. Results of the studies are summarized in Table 1. Two days after spraying, higher levels were found of DDT and dieldrin than of methoxychlor or toxaphene. Methoxychlor disappeared from milk between 14 and 21 days after spraying while others persisted for 21 days or longer.

Additional work on methoxychlor was done recently by Cheng, *et al. (11)*. They found an average of 0.03 ppm insecticide in milk during a 68-day period during which cows were treated daily with a 1-% methoxychlor spray.

Four dairy animals were sprayed with a solution of 1.5 lb of 25-% lindane powder per 100 gal of water. A household detergent, at the rate of two lb per 100 gal, was added to the insecticide solution and applied to two of the cows *(93)*. The highest level of lindane was found in milk one day after spraying and it decreased logarithmically with time. Milk from all treated cows contained lindane 17 days after spraying. Addition of detergent did not affect presence of lindane in milk.

Radeleff, *et al. (75)* sprayed dairy cows with a 0.5-% solution of dieldrin. When a xylene emulsion was used, 5.7 ppm of insecticide appeared in milk after one day, 8.3 ppm after 2 days, 5.5 ppm after 4 days, 2.7 ppm after 14 days and 1.0 ppm after 28 days. Slightly lower residues were detected when a wettable powder suspension was used.

The literature is abundant with studies on residues of different chlorinated hydrocarbons in milk after their ingestion by dairy cows. Only those that seem especially pertinent will be reviewed. DDT residues in the range of 0.5 to 15 ppm were found when cows were fed previously treated alfalfa hay, pea vine or sweet corn silage *(67)*. Other studies showed that 5 to 30% of DDT ingested by cows was recovered in milk. The insecticide appeared in milk 3 days after ingestion of contaminated feeds started and persisted for 160 to 170 days after feeding stopped.

Dairy cows consumed forage from DDT-contaminated pastures and DDT-contaminated hay which resulted from aerial application of insecticide in studies by Huddleston, *et al. (43)* described earlier in this paper. DDT in milk after 7 days ranged from 0.17 to 3.77 ppm; after 30 days, 0.26 to 3.60 ppm; after 60 days, up to 2.20 ppm; after 210 days, 0.26 to 2.90 ppm; and after 325 days, 0.05 to 0.40 ppm.

Different levels of methoxychlor were fed to cows by Gannon, *et al. (29)*. When feed contaminated with 7,000 ppm was fed continuously, 7 days later milk contained 0.83 ppm and after 112 days, 2.14 ppm. Residues in milk dropped to 0.17 ppm after 7 days of feeding and 0.13 ppm after 112 days when

TABLE 1—AVERAGE LEVELS (PPM) OF INSECTICIDES IN MILK BEFORE AND AT DIFFERENT INTERVALS AFTER A SINGLE SPRAY TREATMENT[a] [b]

Time (days)	DDT	Dieldrin	Methoxychlor (*Emulsion*)	Toxaphene (*Emulsion*)
Before spraying	0.2	0.0	0.0	0.0
After spraying				
2	2.8	5.5	0.48	0.61
7	1.4	1.7	0.09	0.16
14	0.7	1.3	0.06	0.07
21	0.6	0.4[c]	0.00	0.08

[a] From data by Claborn, *et al. (13)*.
[b] A 0.5 per cent concentration of each insecticide was used in the spray.
[c] Sampled at 22 days.

[1] Second in a series of three review papers on this subject. For the first of the series see, J. Milk and Food Technol., **25:36.** 1962.

feed contained 800 ppm of insecticide. Other work (67) indicated that methoxychlor did not contaminate milk when previously treated alfalfa was fed. Methoxychlor, when added to milk, was found to be stable for at least 5 days at room temperature.

Dieldrin levels of 0.8 to 1.8 ppm were found in milk when cows were fed previously sprayed alfalfa hay (67). When pastures were treated with the insecticide, milk produced by grazing cows contained 0.04 to 0.96 ppm. Recently studies were conducted in which dieldrin was incorporated into feeds at rates of 75, 50 and 10 ppm (29). After each was consumed by cows for 12 days, milk contained 13.36, 10.96 and 1.78 ppm respectively.

Gannon, *et al.* (30) fed dairy cows with levels of dieldrin ranging from 0.1 to 2.25 ppm of the diet. Appreciable levels of dieldrin were detected in milk from cows fed 2.25 ppm in their diet. The concentration in milk increased from 0.16 ppm after one week of feeding to 0.28 ppm after 12 weeks. Six weeks after insecticide feeding was stopped, milk contained only 0.04 ppm dieldrin.

Aldrin appeared in milk at the rates of 16.1, 3.42 and 0.41 ppm after cows had ingested the insecticide for 112 days in feed contaminated with 40, 10 or one ppm respectively (29). After 7 days of feeding, milk contained 5.22, 1.18 or 0.12 ppm aldrin respectively. Other studies showed milk to be free from aldrin when cows consumed previously sprayed forage for a period of 91 days (67).

Relatively low levels of endrin (0.1 to 1.7 ppm) were found in milk produced by cows which consumed previously treated hay. It was noted that at least 20 mg of endrin had to be ingested daily before the insecticide appeared in milk. No endrin was found in butter made from milk produced by cows that consumed corn stover which, as corn, had been treated with the insecticide (48).

Dairy cows were fed mixtures of heptachlor and heptachlor epoxide at 5 and 10 ppm levels in their diet. Heptachlor epoxide appeared in milk 3 days after feeding started. Maximum accumulations of the epoxide in milk after 15 days of feeding were 0.72 ppm at the 5-ppm level and 1.59 ppm at the 10-ppm level (83). Heptachlor was not detected in milk from cows pastured on corn stover which, as corn, had been treated with the insecticide to control the European corn borer (49). Butterfat from cows exposed to a range treated with 2 oz per acre of heptachlor contained 13.3 ppm heptachlor epoxide after 28 days and 1.0 ppm after 165 days (3).

Table 2 summarizes data obtained by Claborn, *et al.* (13) on levels of toxaphene in milk from cows which received different levels of insecticide in their feed. Increases in oral intake were accompanied by increases in milk contamination. Feeding the insecticide for periods longer than two weeks did not seem to increase residues appreciably. Residues continued to appear in milk for two to three weeks or longer after feeding of the insecticide had discontinued.

TABLE 2—AVERAGE LEVELS (PPM) OF TOXAPHENE IN MILK FROM COWS DURING AND AFTER FEEDING OF DIFFERENT CONCENTRATIONS[a]

	After feeding (weeks)				After feeding ceased (weeks)		
Dosage	2	4	6	8	1	2	3
(*ppm*)							
Control	0.01	0.06	0.16	0.00	0.00	0.00	0.00
20	0.26	0.36	0.37	0.23	0.07	0.02	-
60	0.61	0.68	0.71	0.48	0.13	0.10	0.07
100	1.01	1.15	0.96	0.91	0.15	0.13	0.12
140	1.67	1.89	1.64	1.82	0.32	0.40	0.20

[a]From data by Claborn, *et al.* (13).

A series of tests were conducted by Gannon and Decker (28) in which pastures were treated with 0.5, 3.0 and 0.5 lb per acre of dieldrin, DDT and heptachlor. When cows were allowed to graze treated pastures immediately afterward, the chemicals reached their maximum concentration in milk within 3 to 7 days (dieldrin - 3.0 to 4.0 ppm, DDT - 7.0 to 8.0 ppm, heptachlor epoxide - 0.22 ppm) and declined steadily thereafter.

A limited amount of published data is available on residues of insecticides in dairy products made from contaminated milk (68). One study indicated that butter with 65 ppm DDT was made from milk which contained 2.3 to 3 ppm of insecticide. Other investigations reported still higher DDT levels in butter. Original milk contained 26 ppm and butter made from it had 456 to 534 ppm. A variety of dairy products made from DDT-contaminated milk were tested and the following DDT levels found: pasteurized cream, 70.2 ppm; buttermilk, 1.9 ppm; whey, 0.5 ppm; butter, 100 ppm and Cheddar cheese, 47.0 ppm. Highest DDT levels were observed in high-fat dairy products. One investigation demonstrated that benzene hexachloride appeared in butter after

TABLE 3—AVERAGE LEVELS (PPM) OF INSECTICIDES DEPOSITED IN FAT OF STEERS AND HEIFERS AT DIFFERENT TIMES AFTER A SINGLE SPRAY TREATMENT[a]

	Time after spraying in weeks					
Insecticide and concentration used	2	6	10	16	22	27
DDT (0.5%)	11.2	8.1	5.3	2.3	2.8	1.7
TDE (0.5%)	11.0	5.2	3.9	1.1	0.7	0.5
Methoxychlor (0.5%)	2.8	1.7	0.0	-[b]	-	-
Lindane (0.075%)	6.2	0.9	-	-	-	-

[a]Data from Claborn, *et al.* (13).
[b]No results reported.

cows had grazed on pastures previously sprayed with the insecticide.

BEEF TISSUES

Chlorinated hydrocarbons may be deposited in tissues of certain animals after exposure to the insecticide through a spray treatment or after oral ingestion.

Table 3 summarizes data gathered by Claborn, *et al. (13)* on levels of different insecticides deposited in fat of steers and heifers after a single spray treatment. A DDT residue of 11.2 ppm was found after 2 weeks. This gradually decreased so that 27 weeks after spraying, 1.7 ppm was present. Similar results were obtained with TDE although depletion was more rapid than DDT. The level of methoxychlor was 2.8 ppm after 2 weeks but was completely depleted after 10 weeks. Lindane was present at a level of 6.2 ppm after 2, and 0.9 ppm after six weeks. The same authors *(13)* also studied effects of repeated spray treatments on depostion of insecticides in fat of steers and heifers. Results of this work are summarized in Table 4. After the first spray treatment, fat contained 18 ppm DDT. This increased to 35.2 ppm after the sixth spraying. The insecticide persisted so that 36 weeks after the last spraying fat still contained 2.2 ppm. Similar results were noted when TDE was used. Levels of methoxychlor never exceeded 2.4 ppm during the spray treatment and were reduced to zero 12 weeks after the last treatment. Lindane was never found during the treatment period. When dieldrin was used, fat contained 7 ppm after the first spray treatment, 24.0 ppm after the fourth and 6 ppm 28 weeks after the last spraying. Use of heptachlor caused deposition in fat of 11.2 ppm after the first treatment, 19.3 ppm after the sixth and 2 ppm 16 weeks after the final spraying. Similar results were obtained with gamma chlordane while levels of toxaphene reached 4 ppm after the sixth treatment, 14.0 ppm after the 12th spraying and 3 ppm six weeks after the final spray.

Several studies have been reported on deposition of chlorinated hydrocarbons in fat and other tissues of cattle after oral ingestion. Claborn, *et al. (13)* investigated effects of feeding 10 different insecticides at several concentrations for up to 16 weeks on levels deposited in fat. Results are summarized in Table 5. In general it can be said that concentration of insecticide in fat increased as the dosage and length of feeding increased. Methoxychlor failed to accumulate in fatty tissue while lindane, toxaphene, chlordane, heptachlor and endrin were deposited to a lesser degree than aldrin, BHC, DDT or dieldrin. Fat levels as high at 250 ppm BHC, 40 ppm aldrin, 44 ppm endrin, 40 ppm DDT and 50 ppm lindane were observed after feeding insecticides for 16 weeks.

Gyrisco, *et al. (40)* studied deposition of DDT, lindane and aldrin in various tissues of dairy cattle. After a cow was fed DDT (2-10 ppm) for 3 months, 0.6 ppm was recovered from kidney tissue, 6.6 ppm from omental fat and 0.13 to 0.18 ppm from manure. A similar experiment with lindane resulted in an accumulation of 0.25 ppm of this insecticide in omental fat and 0.08 ppm in the kidney. No insecticide was found in manure. When aldrin was fed at the rate of 10 ppm, none was detected in the pancreas, kidney, liver, spleen, brain or omental fat. A trace was noted in manure.

Dieldrin accumulation in tissues of steers and cows was investigated by Gannon, *et al. (30, 31)*. The insecticide was fed at levels of 0.1 to 2.25 ppm in the diet for 12 weeks. After 12 weeks of feeding, brain and kidney tissue were free from contamination regardless of dosage levels. Other tissues studied showed increasing levels. Highest levels attained were 0.6 ppm in the heart, 0.7 ppm in the liver, 6.2 ppm in renal fat, 4.8 ppm in body fat, 7.0 ppm in heart fat, 5.6 ppm in udder fat, 1.3 ppm in steak and

TABLE 4—AVERAGE LEVELS (PPM) OF INSECTICIDES DEPOSITED IN FAT OF STEERS AND HEIFERS AT DIFFERENT TIMES AFTER REPEATED SPRAY TREATMENTS[a]

Insecticide and concentration used	Spray interval	After indicated spray application: 1	2	4	6	After last spraying (weeks): 8	12	16	24	36
	(weeks)									
DDT (0.5%)	3	18.0	31.2	32.8	35.2		7.7		4.7	2.2
TDE (0.5%)	3	13.2	32.7	36.5	28.4		13.6		1.3	0.8
Methoxychlor (0.5%)	3	1.5	1.5	0.8	2.4		0.0			
Lindane (0.03%)	3	NONE AFTER ANY SPRAYING								
Dieldrin (0.05%)	3	7.0	10.0	24.0[b]						
Heptachlor (0.5%)	2	11.2	13.6	19.1	19.3	15.5		2.0		
Gamma Chlordane (0.5%)	2	8.7	10.0	17.1	24.0	15.6		0.3		
Toxaphene (0.5%)	2	0.0	0.0	6.0	4.0[c]					

[a]Data from Claborn, *et al. (13)*.

[b]Residue of dieldrin 11 wks. after last spray: 17.0 ppm; 28 wks. after last spray: 6.0 ppm.

[c]Residue of toxaphene after 12th spraying: 14.0 ppm; 4 wks. after last spray: 5.0 ppg; 6 wks. after last spray: 3.0 ppm.

TABLE 5—AVERAGE LEVELS (PPM) OF INSECTICIDES DEPOSITED IN FAT OF CATTLE AFTER ORAL ADMINISTRATION[a]

Insecticide	Dosage	After feeding to cattle for weeks			
		4	8	12	16
	ppm				
Aldrin	10	35	41	44	49
	25	50	78		
BHC	100	159	223	230	250
Chlordane	10	11	13	10	11
	25	12	18		
DDT	10	6.8			
	25	22	3.4	42	40
Dieldrin	1.0	1.8	3.9	2.0	2.6
	2.5	7.0	11.4	10.2	14.3
	10	16	26	35	44
	25	75	74		
Endrin	2.5	1.2	2.6	0.8	0.8
	5.0	1.3	1.5	2.4	2.3
Heptachlor	2.5	1.4	0.7	0.7	0.2
	10.0	4	8	3.5	7.5
Methoxychlor	25	0	0	-	0
Toxaphene	25	2	4	10	12
	100	26	34	33	38
Lindane[b]	1	0.3	0.9	1.7	1.0
	10	3.5	6.8	8.0	3.1
	100	65.0	76.0	99.0	50.0

[a]From data by Claborn, *et. al (13).*
[b]From data by Radeleff, *et al. (74).*

1.2 ppm in roast. Six weeks after feeding of the insecticide had ceased, levels in different tissues had decreased by 50% or more in most instances.

Additional work on accumulation of dieldrin in tissues of steers was reported by Claborn, *et al. (13)* and is summarized in Table 6. Highest levels of deposition were noted in body and renal fat while less was detected in muscle tissue.

Radeleff, *et al. (75)* studied residues of dieldrin in omental fat of Hereford cattle after they were sprayed 3 times in 5 days with 0.5% insecticide. Tests on four animals showed residues of 8 to 70 ppm 6 days after the third spray. After 15 days, 4 to 11 ppm dieldrin was found and after 19 days the range was 4 to 10 ppm. Less than 1.0 ppm insecticide was found after 24 days.

Studies on deposition of a variety of insecticides in the fat of cattle were conducted when the chemicals were used to control grasshoppers on rangeland *(1)*. In 1956 cattle exposed to rangeland treated with 2 oz per acre of aldrin averaged 1.4 to 10.9 ppm dieldrin in their fat at slaughter. In 1957 steers were exposed for 58 to 90 days to rangeland treated with 2 oz aldrin, 3 oz heptachlor or 0.75 oz dieldrin per acre after which they were confined in a feed lot for 93 or 100 days. Dieldrin residues from the aldrin treatment were about 4 ppm in fat when cattle were removed from the range and about 0.9 ppm when slaughtered. Heptachlor epoxide residues from heptachlor treatment were of the same magnitude. Residues of dieldrin were about 7 ppm when animals were removed from the range and 1.4 ppm when slaughtered. In 1958 cattle were grazed for 96 or 103 days on ranges treated with 2 oz of aldrin or heptachlor per acre in diesel oil or emulsion or 1.5 lb toxaphene in diesel oil after which they were confined to a feed lot for 120 days before slaughter. Dieldrin and heptachlor epoxide residues were about the same as in 1957. Samples taken at time of slaughter showed that aldrin residues were only slightly affected by formulation but heptachlor epoxide residues were lowest in animals on emulsion treated range. In animals exposed to toxaphene, residues were less than 0.5 ppm.

TABLE 6—DIELDRIN (PPM) IN DIFFERENT TISSUES OF STEERS FED VARYING LEVELS FOR 12 WEEKS[a]

Dosage	Dieldrin in				
	Body fat	Renal fat	Liver	Kidney	Muscle
(ppm)	*(ppm)*	*(ppm)*	*(ppm)*	*(ppm)*	*(ppm)*
0	0	0	0	0	0
0.25	0.84	0.73	0.05	0.01	0
0.75	2.75	2.35	0.18	0.32	0.04
2.00	6.80	6.00	0.50	0.45	0.13
10.00	23.50	31.90	2.39	2.41	0.45

[a]Data from Claborn, *et al. (13).*

SWINE TISSUE

Deposition of aldrin, heptachlor and toxaphene in fat of swine grazing on Ladino clover pastures previously treated with these insecticides has been reported *(15)*. When heptachlor was applied at a rate of 3.6 lbs per acre and toxaphene at a rate of 16.0 lbs per acre, residues of 0.9 and one ppm respectively accumulated in swine fat. Gannon, *et al. (31)* added from 0.1 to 2.25 ppm dieldrin to the diet of swine. Highest insecticide residues, after 12 weeks of feeding were observed in renal fat and body fat. After 12 weeks on a diet with 2.25 ppm dieldrin, renal fat contained 5.2 ppm; body fat, 3.5 ppm; liver, 0.2 ppm; kidney 0.5 ppm; chops, 1.9 ppm and roast 1.2 ppm. Six weeks after feeding of the insecticide had been stopped, residues in tissues decreased in all instances and in some by 50% or more. Results from other studies on feeding dieldrin to swine are summarized in Table 7 *(13)*. Highest levels accumulated in body and renal fat.

SHEEP TISSUE

Limited studies have been conducted on deposition

TABLE 7—DIELDRIN (PPM) IN DIFFERENT TISSUES OF SWINE FED VARYING LEVELS FOR 12 WEEKS[a]

Dosage	Dieldrin in			
	Body fat	Renal fat	Liver	Kidney
(ppm)	*(ppm)*	*(ppm)*	*(ppm)*	*(ppm)*
0	0	0	0	0
0.25	0.34	0.32	0.02	0
0.75	1.08	0.98	0.03	0.03
10.00	10.80	11.90	0.48	0.59

[a]Data from Claborn, *et al. (13).*

of dieldrin in tissues of sheep after oral ingestion *(31).* One investigation showed no residues present in liver, kidney, or chops when 2.25 ppm insecticide in the diet was fed for 12 weeks. Residues were only 1.9 ppm in renal fat, 1.5 ppm in body fat and 0.2 ppm in roast. Table 8 summarizes results of other studies on sheep. Highest levels of insecticide were observed in body and renal fat of sheep.

Long, *et al. (64)* treated a pasture with 0.25 lb endrin per acre on May 19, June 10, June 16, June 23 and June 29, 1958. Lambs were placed on the pasture on May 19 and allowed to graze for 55 days. After removal of lambs from this pasture to an untreated one, fat samples were analyzed periodically for endrin residues. Immediately after removal, internal fat (from around the stomach and thoracic cavity) contained 20.8 ppm and external fat (from external surfaces of the carcass and fat pockets in meat) contained 12.8 ppm. Fourteen days later residues in internal and external fats were 22.0 and 17.4 ppm respectively. When lambs had not grazed on the treated pasture for 42 days, internal fat contained 11.4 and external fat 8.7 ppm of endrin.

Sheep were dipped in a 0.025 per cent lindane solution in experiment by Jackson, *et al. (46).* Two weeks after treatment, fat from the animals contained 4.23 ppm of insecticide. This dropped to 1.75 ppm after 4 weeks and to 0.27 after 10 weeks. No lindane was recovered from fat of treated sheep 12 weeks after they were dipped.

TABLE 8—DIELDRIN (PPM) IN DIFFERENT TISSUES OF SHEEP FED VARYING LEVELS FOR 12 WEEKS[a]

Dosage	Dieldrin in				
	Body fat	Renal fat	Liver	Kidney	Muscle
(ppm)	*(ppm)*	*(ppm)*	*(ppm)*	*(ppm)*	*(ppm)*
0	0	0	0	0	0
0.25	0.45	0.49	0.07	0.03	0.01
0.75	1.84	1.70	0.14	0.12	0.03
10.00	30.70	28.9	2.22	0.98	0.50

[a]Data from Claborn, *et al. (13).*

POULTRY TISSUE

Experiments on deposition of DDT in tissues of growing turkeys were described by Marsden and Bird *(65)* in 1947. When the diet contained 0.15 ppm DDT and was fed for 7 weeks, residues of insecticide in mg per g of tissue were 0.18 for muscle, 0.17 for kidney and 6.24 for fat. A study with dieldrin indicated that fat of hens contained 35.7 ppm after ingesting a diet with 0.75 ppm for 12 weeks *(31).* Endrin was found in fat at a level of 1.07 ppm after hens had consumed a diet with 0.75 ppm for 4 weeks *(88).* The skin and flesh of chickens were found contaminated with 3.20 and 0.17 ppm of BHC respectively after birds had been exposed for 21 days to roosts treated with a 1.2 per cent suspension of insecticide *(24).* Dusting chickens with 10 g of a 1-% dieldrin preparation resulted in the presence of 0.8 ppm insecticide in their fat one week later and one ppm after 12 weeks *(22).* One report indicated that flesh of broilers became contaminated with chlordane after birds inhaled a mist of the insecticide *(70).*

Ivey, *et al. (45)* found 131 ppm lindane in the fat of poultry one week after their quarters were sprayed with one gallon of a 1-% lindane suspension, per 100 square feet. The residue level increased to 133 ppm after 4 weeks, 140 ppm after 6 weeks and 225 ppm after 8 weeks. A decline started then and after 16 weeks, 97 ppm remained. When the same spray was applied to 1,000 square feet, 4.2 ppm insecticide was found in fat one week later. This increased to 6.6 ppm after 2 weeks and then gradually decreased so that after 20 weeks, 1.0 ppm remained.

EGGS

Chlorinated hydrocarbons may also be deposited in eggs produced by hens exposed to the insecticides. A mash prepared with 15 per cent alfalfa meal made from hay previously treated with one, 2, or 4 pounds DDT per acre was fed to White Leghorn hens *(17).* DDT content of eggs produced when the different alfalfa meals were used was 2.5, 2.8 and 6.4 ppm respectively. When 50, 100 and 200 ppm DDT were added directly to mash, the average insecticide content of all eggs produced during a 17-month period was 18, 34 or 46 ppm respectively. The DDT content, on a dry basis, of whole egg was an average of 171 ppm when mash consumed by hens contained 100 ppm insecticide. The albumin of these eggs contained an average of 15 ppm DDT (dry basis) while yolks contained an average of 323 ppm (dry basis) *(17).*

When DDT was used an an aerial spray to control the gypsy moth in the study described previously *(43),* it was noted that 0.57 ppm insecticide appeared

in eggs on the day after application. After one month 0.12 ppm was still present.

Eggs produced by hens which were fed 0.75 ppm endrin in their diet for 4 weeks contained 0.17 ppm of insecticide *(88)*. When a diet containing 0.75 ppm dieldrin was fed to hens for 6 weeks, eggs contained 0.2 ppm insecticide. After 12 weeks of feeding the level in eggs was 1.2 ppm *(31)*.

A study was conducted by Ivey *et al. (45)* to determine if lindane residues appeared in eggs produced by hens confined in houses sprayed with the insecticide. A 1-% suspension of lindane was used and, in one test, one gal treated 100 square feet while in the other, one gal was applied to 1000 square feet. When the heavier application was used, one week after spraying, eggs contained 13 ppm insecticide. This increased to 16 ppm at 3 weeks, to 20 ppm at 8 weeks and dropped to 15 ppm after 12 weeks. Insecticide residues in eggs were considerably lower when the light spray application was used. After one week, 0.53 ppm was noted. This increased to 0.81 ppm and then gradually declined so that after 16 weeks only 0.08 ppm remained and after 20 weeks no residue could be detected.

REFERENCES

The complete list of references cited will be included with the third paper of this series.