

# Organochlorine Pesticides in Rainwater, Oahu, Hawaii, 1971-1972

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The vapor pressures of many pesticides are sufficiently high to assure losses from plants, soil, surface water slicks, and building structures into the atmosphere, and Abbott *et al.* (1965) suggested that pesticides are carried in the atmosphere either as vapors or by occlusion on dust particles and are subsequently "scrubbed out" by rain and snow. Woodwell *et al.* (1971) noted that the primary mechanism for the removal of DDT from the atmosphere was probably rainfall. Schmidt *et al.* (1971) reported that aerial fallout was one source of polychlorobiphenyl (PCB's) contamination, and Reynolds (1971) attributed part of this contamination to the burning of wastes containing PCB's. The possibility that translocation of pesticide residues could, in part, be attributed to fallout by rainwater was shown to be a fact by Cohen and Pinkerton (1966) in 1964, but not all of the organochlorine content of the rainwater could be ascribed to pesticides. Wheatley and Hardman (1965) and Tarrant and Tatton (1968) reported similar findings from rainwater in England, with the additional observation by Tarrant and Tatton that small amounts of PCB's were present in all samples; however, the PCB's were not quantified.

Pesticide residue data were obtained from rainwater samples in Hawaii for the period 1971-1972 and the results are given in Table 1. Samples were collected in one-gallon glass containers protected from sunlight with a covering of aluminum foil. Precautionary measures against contamination during sampling and analysis were taken as previously described (BEVENUE *et al.* 1971). Analysis of the samples for residues were made by gas chromatography as previously described (BEVENUE *et al.* 1972). The methyl and ethyl ether derivatives of pentachlorophenol (PCP) were prepared for gas chromatography and a third derivative, pentachlorophenyl acetate, was also used for the confirmation of the presence of PCP (RUDLING 1970). During this study,

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TABLE 1

Organochlorine Pesticides in Rainwater, Oahu Hawaii, 1971-1972  
Nanograms per Liter (parts per trillion)

Area of Oahu Sampled	Time Period	Chlordane	p,p'DDT	Dieldrin	Lindane	PCP*	Total
Kailua	1-5-72 to 1-23-72	3	4	6	3	20	36
Kaneohe	9-30-71 to 11-17-71	2	9	7	2	8	28
	1-4-72 to 1-25-72	3	3	2	1	11	20
	1-28-72 to 2-23-72	N.D.**	1	4	N.D.	16	21
	2-28-72 to 3-4-72	N.D.	1	2	1	15	19
	3-4-72 to 4-27-72	N.D.	2	1	1	10	14
Waipahu	1-6-72 to 3-4-72	3	1	4	4	14	26
Honolulu							
Nuuanu-Vineyard Aves.***	1-6-72 to 3-4-72	N.D.	1	4	5	16	26
Nuuanu-School Sts.	9-28-71 to 12-27-71	N.D.	6	97	2	77	182
Nuuanu-School Sts.	1-1-72 to 2-23-72	N.D.	3	19	2	45	69
Nuuanu-School Sts.	2-25-72 to 5-15-72	N.D.	14	9	9	2	34
Pawaa Lane	1-1-72 to 2-20-72	2	5	6	3	55	71
Pawaa Lane	2-27-72 to 5-11-72	1	5	4	3	50	63
Manoa****	9-30-71 to 11-15-71	N.D.	3	3	2	284	292
Manoa****	1-3-72 to 1-24-72	---- Not Determined				270	270
Range		N.D.-3	1-14	1-97	N.D.-9	2-284	
Average		1	4	12	3	60	78

\* PCP = Pentachlorophenol

\*\* N.D. = None detectable

\*\*\* Sampled from roof of building 24 stories above street level

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a sample of snow from Mauna Kea Summit (13, 800 ft) and a sample of water from Lake Waiiau (fed almost exclusively by the Summit snows) from the island of Hawaii were also examined for pesticides; the analytical results are given in Table 2.

TABLE 2

Organochlorine Pesticides in Snow and Lake Water  
Nanograms per Liter (parts per trillion)

	p,p'-DDT	Dieldrin	Lindane	PCP	Total
Snow	15	2	3	14	34
Lake Water	5	1	5	10	21

The total organochlorine residues in Hawaiian rainwater are in the low parts per trillion range and are comparable to previous analyses made during the period 1970-1971. The residue values for the snow and lake water were in the same range noted in the rainwater. The Hawaiian values are considerably lower than those reported in other areas (Table 3). However, the comparative 6 to 7 year-old data may not be wholly legitimate because of increased restrictive pesticide controls initiated during the past several years.

TABLE 3

Comparative Data on Organochlorine Pesticides in  
Rainwater in Different Areas  
Nanograms per Liter (parts per trillion)

Area	Time Period (year)	Lindane	Dieldrin	p,p'-DDT	Chlordane	PCP
England <sup>a</sup>	1964-1965	75	19	3		
England <sup>b</sup>	1966-1967	60	8	46		
Ohio (USA) <sup>c</sup>	1965	25		150		
Hawaii (USA) <sup>d</sup>	1970-1971	5	5	3	not determined	
Hawaii (USA)	1971-1972	3	12	4	1	60

a. WHEATLEY and HARDMAN, 1965

b. TARRANT and TATTON, 1968

c. COHEN and PINKERTON, 1966

d. BEVENUE et al., 1972

Under the conditions of this study, no PCB's were detected. The pesticides observed could be readily detected at the 1 p.p.t. level; however, PCB's, such as the Aroclors 1248, 1254, and 1232, would require about 20 to 40 p.p.t. of each for minimum detection.

Although all of the observed residues were in the parts per trillion range, a distribution pattern is possibly noted in the different areas of Oahu (Table 1). Kailua and Kaneohe are primarily residential areas and separated from Honolulu by a mountain range. Waipahu is located about 15 miles west of Honolulu. These three areas indicated a lower residue level than the Honolulu area; the latter area is a crowded, complex mixture of residential, commercial, and industrial establishments. Dieldrin is used to some extent in residential areas for termite control and, for a similar reason, a large percentage of all construction lumber used on the island is pretreated with chemical formulations containing PCP, which may account for the consistent presence of residues of this chemical in the local environment.

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