was clamped to the metering bottle shelf and rubber tubing was connected from each valve to an intake duct on the stirrer. A length of rubber tubing was connected to the outlet duct of the stirrer so that the outflow from the stirrer could be emptied away from the testing equipment. A 2-inch magnetic bar coated with teflon, inserted in the metering bottle, was rotated by the water-powered magnetic stirrer, which provided an adequate mix of the larvicide. The stopcock on the gas burner valves permitted the regulation of the flow of water to each stirrer and thus the speed of the stirrer could be controlled. Also the intake line from the pump to the stirrer manifold was provided with a valve to help control the water flow to the stirrer manifold.

The magnetic stirrers were made of two plastic halves. Occasionally there were leaks from the seam where the two halves were joined. This leak was stopped by pasting a ½-inch wide strip of cellulose acetate, 30 mils in thickness over the junction seam. A mixture of cellulose acetate and acetone was used for pasting the plastic strip.

The use of the plastic stirrers described above has decided advantages over other methods investigated. The stirrers, which can be purchased from the Chemical Rubber Company of Cleveland, Ohio for $9.95 each, are light and compact, can be operated without electricity, and being driven by running water are virtually impossible to overheat or burn out. It is likely therefore that they can be of value to other workers who have found the need for stirring chemicals under field conditions.

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ADDITIONAL TESTS WITH BLACKFLY LARVICIDES [1]

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Simulated stream tests were continued near Ithaca, N. Y. to develop better materials and methods for the control of blackfly larvae (Travis and Wilton, 1965). The results reported here are in part to recheck similar tests of 1965, to test some new compounds, and to gain more information on the mechanism of action of the larvicides. These results are presented as a progress report.

Equipment and Materials. All tests were conducted with equipment which was a modification of that described by Wilton and Travis (1965). In 1965 all suspension and wettable powder formulations were tested with some difficulty. It was necessary to agitate the chemical metering bottles by hand. This year (Guttman, Travis and Crafts, 1966) a set of magnetic stirrers provided a more acceptable method of agitation to keep the larvicides well mixed. The test larvae were *Simulium pictipes* Hagen.

The larvicides used were DDT, lindane and methoxychlor (commercial samples); GS13005, diazinon, dimetilan, and Alfatox, (courtesy Geigy Chemical Co.), Bay-

[1] Thanks are due Robert R. Crafts for his helpful assistance in conducting these field tests.

gon (courtesy Chemagro Corp.), Abate (courtesy American Cyanamid Co.); Thiocron (courtesy CIBA Corp.), paris green (courtesy Agway Inc.) and *Bacillus thuringiensis* (courtesy Geneva, N. Y. Expt. Sta.). All wettable powders were commercial samples. The wettable powders were made up with 1 gram of active ingredient in 100 ml. of a 1 percent Triton X-100 solution. The suspensions were 20 percent ethanol solutions, (weight-volume). The emulsions were either commercial samples or laboratory samples prepared on a weight-volume basis with 20 grams of pesticide and 10 grams of Triton X-100 (courtesy Rohm and Haas Co.) made up to 100 ml. with xylene.

METHODS. Other than for the magnetic stirrers, all test procedures were as previously described by Wilton and Travis (1965) and Travis and Wilton (1965). The test larvae were removed from rocks in the streams and transferred to the test troughs. The troughs were of galvanized metal with Kraft paper liners. A plastic sheet between the paper and the trough prevented contamination of the metal troughs with the pesticides. The plastic and paper liners were used but once so no complicated decontamination of the troughs was necessary.

For each test, 20 larvae were placed in each trough. The pesticides were metered into the water running down the troughs on a p.p.m. basis. The larvae were exposed in the troughs for 15 minutes to the pesticides, and then were left for 5 minutes in untreated water to wash off surplus chemical. A count was made of the larvae that had detached by the end of the 15-minute exposure to the chemicals and the 5-minute wash. Then the larvae were transferred to nylon bags and were placed back in the stream in a holding cage. Control and test larvae were checked for 24- and 48-hour mortalities.

The water temperatures ranged from 52° to 72° F. Water volumes were generally good in the streams. For most of the tests the water temperatures were close to 5° F. lower than for the 1965 tests.

Tests were made to determine if a significant amount of pesticide was being absorbed by the paper trough-liners to affect larval mortality. To check on the absorption two troughs were used, each 12 feet long. Larvae were exposed to the pesticides in the upper 6 feet of one trough and in the lower 6 feet of the second trough. Thus the pesticides passed over 6 more feet of paper for the larvae in the lower than in the upper position. Any difference in mortality might be caused by absorption of the pesticides on the paper.

RESULTS. Some preliminary tests in 1965 indicated that absorption of pesticides on the paper liners was not significant. Additional tests, Table 1, confirmed that there

TABLE 1.—Comparison of mortalities when pesticide emulsions at dosages of 0.5 p.p.m. were run through either one or two paper-lined troughs, 3 replications (M=avg. percent 48-hour mortality; D=avg. percent larval detachment during tests).

Pesticides	No. trough sections			
	1		2	
	M	*D*	*M*	*D*
DDT	68	5	73	12
Diazinon	75	3	78	7
Methoxychlor	73	63	73	75
6 controls average mortality 24%				

was no significant difference between larvae exposed to pesticides that had passed over either one or two troughs lined with the paper. There were some differences in detachment but these differences are not significant.

The data in Table 2 are a summary of results with the different pesticides dosages and formulations. As there were so many moribund larvae at the 24-hour observation, only the data for the 48-hour mortalities are presented in the table. The data in general confirm those obtained in 1965. The mortality and detachment percentages are a bit lower than in 1965 for the same materials. However, the order of effectiveness of the same materials is the same for both 1965 and 1966.

Judged on mortality of larvae, the best material was Baytex, the intermediate ma-

TABLE 2.—Comparisons of several insecticides, formulations and concentrations (M=Avg. percent 48-hours mortality; D=Avg. percent larval detachment during tests).

		Number of tests, percent mortality (M) and detachment (D) at indicated dosage in p.p.m.											
		1.00			0.50			0.25			0.12		
Pesticide	Formul. 1/	No. tests	M	D	No. tests	M	D	No. tests	M	D	No. tests	M	D
DDT	E	..	..	..	3	68	5	..	..	..	..	..	..
	S	3	95	30	2	82	33	2	58	6	3	53	13
	WP	5	62	1	4	74	1	3	77	1	5	64	2
Diazinon	E	..	..	..	3	75	3	..	..	..	..	..	..
	S	4	61	19	3	32	6	3	38	2	4	16	1
	WP	3	100	17	3	76	12	1	35	5	3	33	0
Methoxychlor	E	..	..	..	3	73	63	..	..	..	..	..	..
	WP	5	44	54	4	32	18	5	51	10	5	62	1
GS13005	E	5	90	85	4	41	37	4	58	3	5	25	3
	S	5	71	44	5	65	18	3	20	7	5	26	2
	WP	6	81	40	5	70	25	4	59	7	6	39	8
Lindane	S	5	66	32	3	55	38	3	35	52	4	30	39
	WP	6	43	35	5	38	33	4	34	25	6	41	19
Baygon	E	3	17	65	2	22	30	1	20	75	3	15	77
	WP	14	17	56	..	..	..	..	..	..	..	..	..
Thiocron	E	6	23	3	6	19	3	3	7	3	5	5	0
Baytex	E	5	100	4	5	100	2	4	82	0	6	61	1
	S	4	100	0	2	97	0	2	92	0	4	49	0
Abate	WP	2	83	3	2	63	0	1	50	5	2	28	3
Dimetilan	S	4	14	1	3	9	1	3	3	3	4	11	2
Alfa-tox	E	8	49	84	6	31	79	7	27	33	7	8	15
		56 controls average mortality 13 percent											

[1] Formulations: E=emulsion; S=suspension (ethanol solution); WP=wettable powder.

terials were DDT, diazinon, methoxychlor, Abate, lindane, and GS13005. The least effective materials were Alfa-tox, Thiocron, Dimetilan, and Baygon. There were enough reversals that no one formulation was superior for all insecticides. Data for *Bacillus thuringiensis* at dosages of 0.2 to 10.0 p.p.m. showed mortalities of from 12 to 32 percent; for paris green the results for one test at each dosage were: 75 percent, 30 percent, and 35 percent, at the respective dosages of 5, 2, and 0.5 p.p.m. Detachment figures for the bacteria and paris green did not exceed 5 percent at any concentration tested.

Judged on detachment of larvae the best materials were: Alfa-tox (E), GS13005 (E), methoxychlor (E), Baygon (E, WP), and lindane (S). The intermediate materials were DDT (S), methoxychlor (WP), GS13005 (S, WP), and lindane (WP). The least effective materials were: DDT (WP), Thiocron (E), Baygon (E, S), Abate (WP) and dimetilan (S).

DISCUSSION. Some unexplained complications were encountered with the 1965 tests which made it necessary to discard all the tests for the month of June. For some reason control mortalities were commonly 30 to 50 percent. It was noted that the larvae where the June tests were conducted were quite inactive and were very limp. In fact, some of the larvae that were transferred directly from the stream to the holding bags without exposure in the test troughs appeared moribund when collected from the stream. Even later in the season, July to September, the control mortalities were much lighter than in 1965. As no tests were conducted until July 1964 it is not known if the early larvae exhibited the same mortality problems as in 1965.

The streams were unusually low during both seasons. It is possible that some toxic agents may have been entering the streams from agricultural lands in sufficient quantities to cause come larval mortalities. From the appearance of the larvae the best guess seems to be that there were disease organisms causing the trouble. The disease possibility will be checked this coming season.

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RESULTS OF MULTIPURPOSE WATER MANAGEMENT STUDIES ON MARSHES ADJACENT TO THE GREAT SALT LAKE, UTAH [1]

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Introduction. Along the eastern shores of the Great Salt Lake is a strip of land varying from 2 to 18 miles in width and about 55 miles in length encompassing approximately 510 square miles. As late as 1872 this entire area was inundated by the water of the Great Salt Lake. Where usable water is available, this land is being developed primarily as marsh for wildlife and as pasture for livestock. Approximately 56 square miles of ground adjacent to this strip and slightly higher in elevation are irrigated to produce salt-tolerant forage and grain crops.

Approximately 70 percent of the human population of the state live between this strip of lake shore land and the abrupt front of the Wasatch Mountains. The population of this area has increased 17 percent during the past five years. As a result of this rapid increase in the population, greater attention has been directed towards the ownership and use of this lake shore land and water.

Some current water management practices along the lake shore are responsible for the production of pest and potential disease-transmitting mosquitoes, gnats, horse flies, deer flies and other noxious insects. The development of some waterfowl marshes has increased the production of mosquitoes and other noxious insects which could largely have been prevented had abatement measures been included in the development plans. Prolonged and/or careless irrigation of pasture and other crops has created prolific mosquito production, and in some instances, with detrimental effects to the intended crop. It is recognized that there is a need for more information on the relationship between the production of mosquitoes and other noxious insects and planned multipurpose water use. This information should include the necessary requirements for wild-

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