mosquitoes by a "one-shot" dosage of the aquatic environment. A cumulative seasonal larvicidal level might be consolidated into one early spring application of "metered" pellets with no accompanying danger to food-chain organisms. Such rubber or plastic formulations could bring about increase in payload efficiency with an accompanying decrease in labor and equipment costs for an efficient mosquito larviciding program.

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LABORATORY TESTS OF PROMISING MOSQUITO LARVICIDES

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Investigators at the Insects Affecting Man and Animals Research Laboratory of the Insects Affecting Man and Animals Research Branch, Entomology Research Division, Agricultural Research Services, U. S. Department of Agriculture continually develop and evaluate effective mosquito larvicides. Part of this program involves the primary screening of candidate compounds against larvae of *Anopheles quadrimaculatus* Say. Those that give 100 percent kill of larvae at a concentration of 0.1 p.p.m. in these tests and that are not highly toxic to mammals (oral LD_{50} to rats or mice of 50 mg/kg or higher) are then tested to determine the dose-mortality response. The present paper reports the results of tests made from 1965 to 1967 with 14 promising compounds. Screening data obtained for six other compounds that were toxic to larvae but had high mammalian toxicity are given.

TESTING TECHNIQUE. The chemicals were dissolved in acetone and added to 225 ml. of distilled water in glass jars. After about 1 hour, 25 fourth instar larvae

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TABLE 1.—Toxicity of 14 larvicides to larvae of fourth-instar *A. quadrimaculatus*.

Larvicide	LC_{50}	LC_{90}	Ratio [a]	Acute oral toxicity to rats (LD_{50} in mg/kg)
Dursban	0.0020	0.003	4.3	145
Bay 78182	.0024	.0040	3.2	>1000
Shell SD-9098	.0040	.0078	1.6	109–286
Bay 77488	.005	.01	1.3	>1000
DDT (standard)	.0056	.013	1	250
CIBA C-9491	.009	.014	.93	2000
Montecatini L 561	.0082	.015	.87	>1000
CIBA C-8874	.0094	.016	.81	140
Bay 69047	.014	.023	.57	1140
Stauffer N-4988	.018	.027	.48	89.1
CIBA C-11044	.015	.034	.38	330
Bay 80833	.021	.039	.33	100
Stauffer N-5196	.023	.051	.26	112
Geigy GS-12968	.034	.054	.24	268
Hercules 14504	.054	.096	.14	80

[a] Inverse ratio of the LC_{90} of the material to that of DDT.

TABLE 1a.—Chemical composition of compounds listed in Table 1.

Dursban: (*O,O*-diethyl *O*-3,5,6-trichloro-2-pyridyl phosphorothioate)
Bay 78182: (*O,O*-diethyl phosphorothioate *O*-ester with (*o*-chlorophenyl)glyoxylonitrile oxime)
Shell SD-9098: (*O*-[2-chloro-1-(2,5-dichlorophenyl)vinyl] *O,O*-diethyl phosphorothioate)
Bay 77488: (*O,O*-diethyl phosphorothioate *O*-ester with phenylglyoxylonitrile oxime)
CIBA C-9491: (*O*-(2,5-dichloro-4-iodophenyl) *O,O*-dimethyl phosphorothioate)
Montecatini L 561: (ethyl mercaptophenylacetate *S*-ester with *O,O*-dimethyl phosphorodithioate)
CIBA C-8874: (*O*-(2,5-dichloro-4-iodophenyl) *O,O*-diethyl phosphorothioate)
Bay 69047: (*O*-[3-(isopropylthio) 4-nitrophenyl] *O,O*-dimethyl phosphorothiote)
Stauffer N-4988: (*S*-4-chloro-*m*-tolyl *O*-methyl ethylphosphonodithioate)
CIBA C-11044: (*O*-(2,5-dichloro-4-iodophenyl) *O*-ethyl *O*-methyl phosphorothioate)
Bay 80833: (*O*-3,4-dichlorophenyl *O*-methyl methylphosphonothioate)
Stauffer N-5196: (*S*-[(2,4-dichlorophenoxy)methyl] *O*-ethyl ethylphosphonodithioate)
Geigy GS-12968: (*O,O*-dimethyl phosphorodithioate *S*-ester with 2-ethoxy-4-(mercaptomethyl)-Δ^2-1,3,4-thiadiazolin-5-one)
Hercules 14504: (*O,O*-dimethyl phosphorodithioate *S*-ester with *N*-(2-chloro-1-mercaptoethyl)phthalimide)

of *A. quadrimaculatus* that were susceptible to DDT and 25 ml. of water were placed in each jar. Mortality was recorded after 24 hours. Each compound was tested at a minimum of five concentrations that were known to produce from 0 to 100 percent mortality. All tests were made in duplicate and replicated three times.

RESULTS. The computed LC_{50} and LC_{90} values for each compound and the DDT standard are presented in Table 1 in descending order of toxicity. The toxicity to rats of each of the compounds is also given in Table 1. The chemical composition of each test compound listed in Table 1 is given in Table 1a. Five compounds, Bay 78182, Bay 77488, Bay 67047, CIBA C-9491, and Montecatini L 561, had oral LD_{50}'s to rats of more than 1000 mg/kg.

On the basis of the computed LC_{90}, Dursban ® was about 4.5 times as toxic and Bay 78182 was about 3.0 times as toxic to the larvae as the DDT standard (0.013 p.p.m.). Seven compounds (Shell SD-

TABLE 2.—Larvicides evaluated in screening tests only.

Larvicide	Lowest concentration causing 100% mortality (p.p.m.)	Acute oral toxicity to rats (LD_{50} mg/kg)
Bay 48792	0.1	2.5
Bay 48772	.05	3
Bay 52553	.01	5
Stauffer N-4548	.025	30
Bay 51294	.025	10
Velsicol FCS-303	.025	Unknown

TABLE 2a.—Chemical composition of compounds listed in Table 2.

Bay 48792: (*O*-ethyl *O*-[*p*-(methylsulfinyl) phenyl] ethylphosphonothioate)
Bay 48772: (*O*-methyl *O*-[4-)methylsulfinyl)-*m*-tolyl] methylphosphonothioate)
Bay 52553: (*O*-isopropyl *O*-methyl *O*-*p*-nitrophenyl phosphorothioate)
Stauffer N-4548 (*S*-[[(*p*-chlorophenyl)thio] methyl] *O*-methyl methylphosphonodithioate)
Bay 51294: (*O*-ethyl methylphosphonothioate *O*-ester with 2-chloro-4-hydroxybenzonitrile)
Velsicol FCS-303 (*O*-(4-bromo-2,5-dichlorophenyl) *O*-ethyl phenylphosphonothioate)

9098, Bay 77488, CIBA C-9491, Montecatini L 561, CIBA C-8874, Bay 69047, and Stauffer N-4988 were about 1.5 to 0.5 times as toxic as DDT. The remaining compounds were about one-third to one-seventh as toxic as DDT.

Additional compounds that gave good kills in screening tests but were not tested further because of high mammalian toxicity are listed in Table 2. The chemical composition of each of these compounds is given in Table 2a.

LARVAL DEVELOPMENT OF *AEDES AEGYPTI* (L.) IN USED AUTO TIRES[1]

J. E. KEIRANS

Since the inauguration of the Aedes aegypti Eradication Program in 1964, many new studies on the control of this mosquito have been undertaken, and much new information on its habits has been made available. Tinker (1964) showed that the receptacle most favored as a larval site by *Ae. aegypti* was a used tire. Haverfield and Hoffman (1966) found that the shipment of used tires is probably the most efficient means of dispersing this mosquito and that its larvae are found more often in tires than in any other type of container. The recognition of this fact led to a series of experiments to determine if (1) an auto tire freshly discarded is capable of supporting larval development of *Ae. aegypti*, (2) the length of the larval development span in tires of various ages, and (3) the amount of food available to the larvae in tires of known age.

MATERIALS AND METHODS. Four sites, referred to herein as A, B, C, and D, were selected in and around Savannah, Georgia, each naturally infested with *Ae. aegypti* and each different in its vegetation and proximity to organic food sources for the larvae. All botanical designations are from Small (1933).

Site A. A small ditch beside a frequently used road, the general vegetation being *Phytolacca americana* (pokeweed), *Quercus virginiana* (live-oak), *Quercus ilicifolia* (scrub-oak), *Vitis sp.* (wild

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