was not complete. No mortality occurred in the check dishes or in control tests in which corresponding amounts of oil and acetone only were employed.

Commercial phenothiazine that was of 99 per cent purity was used and most of the tests were run in 1 liter of water containing 20 fourth-stage larvae of *Culex quinquefasciatus* Say. The water temperatures ranged from 68 degrees to 72 degrees F. The larvae were obtained from breeding tubs exposed in the laboratory yard and were considered to be representative of natural field material. In this connection, however, mention should be made of an observation from which it was indicated that the previous diet of the larvae might affect materially the results of such tests. In two experiments with larvae of the same species, which had been reared on a concentrated diet of yeast and dried blood, a mortality of only about 50 per cent occurred when a phenothiazine dilution, from acetone, of 1–1,000,000 was used. These larvae had been reared for experimental purposes and were supplied by the Division of Control Investigations. When larvae from the same source had been kept in clear water overnight, their susceptibility to the poison was not noticeably different from that of specimens from the tubs.

A few tests of phenothiazine solutions, prepared with sulfonated petroleum oil and acetone, have been made in storm-sewer catch basins that were filled with more or less polluted water and contained large numbers of *Culex* larvae. Applications at the rate of 1–500,000 gave a high percentage of mortality under such conditions. While much more experimental work, in comparison with larvicides now in use, will be required to determine whether the material has a possible field of usefulness in practical antimosquito work, it seems desirable to report the results of the laboratory experiments at this time and to describe the method of preparation found to be most effective for these insects.

SUMMARY.—Of several preparations of commercial phenothiazine that were tested on larvae of *Culex quinquefasciatus* Say, the most effective was a solution consisting of 1 part (grams) of the phenothiazine in 20 parts (cubic centimeters) of sulfonated petroleum oil and 5 parts (cubic centimeters) of acetone. The solution is mixed with water, with which it is readily miscible, before evaporation of the acetone occurs. In laboratory experiments with larval material reared under natural breeding conditions the phenothiazine was fatally toxic at dilutions of 1–2,000,000. Larvae that had been reared on an artificial diet of yeast and dried blood, however, were much less affected by the poison until after they had been removed from the food medium for several hours.—3-3-38.

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Effects of Acidity, Alkalinity and Moisture Content of the Soil on Emergence of *Cochliomyia americana* C. & P.

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It has been demonstrated that in swampy areas during wet years the population of *Cochliomyia americana* C. & P. has been very low, and there has been considerable speculation about the cause of this condition. The purpose of the investigation reported in this paper was to evaluate, by means of laboratory tests, the effects of acid and alkaline conditions and the moisture content of

the soil on the emergence of *C. americana*.

METHOD OF TESTING.—White sea sand was treated with dilute sulfuric acid, washed with tap water until acid-free, and thoroughly dried. Tall-form, pint Mason jars were then exactly half filled with this sand, to which were added measured amounts of sulfuric acid, potassium hydroxide and distilled water. Eighty-two cubic centimeters of water are required to saturate completely this measured quantity of the sand. Thus the degrees of saturation listed refer to definite volumes, as follows: Saturated, 82 cubic centimenters; seven-eighths saturated, 71.75 cubic centimeters; three-fourths saturated, 61.5 cubic centimeters; one-half saturated, 41 cubic centimeters; and one-fourth saturated, 20.5 cubic centimeters.

The potassium hydroxide use in this test was titrated against two lots of standard hydrochloric acid, obtained from different sources. All normalities given are correct to at least two decimal places.

After the solutions had been thoroughly mixed with the sand, 100 mature larvae were placed in each jar, four jars at each condition. The jars were covered with screen lids and replaced in their boxes, and the boxes placed in a cabinet containing open pans of water so that the relative humidity was held close to 100 per cent. The temperature was not constant but averaged around 80 degrees F. Counts were made after the flies had emerged and died.

RESULTS OF TESTS.—The results of two tests, one initiated February 8, 1937, testing acid tolerance of larvae (twenty-second generation reared on artificial media*), and the other initiated March 8, testing alkaline tolerance of larvae (twenty-fourth generation reared on artificial media), are combined in table 1. It should be stated here that results of preliminary tests indicate that animal-reared larvae are but slightly more resistant to these adverse conditions than are the larvae reared on artificial media.

Table 1.—Effect of potassium hydroxide, sulfuric acid, and moisture content of sand on emergence of *Cochliomyia americana* C. & P.

Solution Applied	Per Cent Emergence from Larvae Dropped in Sand				
	¼ Saturated	½ Saturated	¾ Saturated	⅞ Saturated	Saturated
Test of March 8, 1937; 400 larvae (24th generation on artificial media) at each condition; pupal weights approximately 50 mg.					
4.00 N KOH	10.75	5.25	0.00	0.00	0.00
3.00 N KOH	10.25	4.75	0.00	0.00	0.00
2.00 N KOH	17.00	9.00	0.00	0.00	0.00
1.00 N KOH	47.50	22.00	2.75	0.00	0.00
0.50 N KOH	62.75	30.00	8.75	3.75	0.50
0.25 N KOH	84.75	70.50	48.75	30.50	7.25
Distilled water	96.75	94.50	88.25	78.00	62.75
0.05 N H_2SO_4	83.25	73.50	58.25	39.50	29.50
Test of February 8, 1937; 400 larvae (22nd generation on artificial media) at each condition; pupal weights approximately 45 mg.					
Distilled water	92.50	88.75	78.25	60.25	54.00
0.05 N H_2SO_4	76.25	63.75	51.00	50.50	34.00
0.10 N H_2SO_4	65.25	37.75	29.75	18.00	10.00
0.20 N H_2SO_4	50.00	23.25	15.75	4.25	2.25
0.40 N H_2SO_4	22.50	2.25	0.00	0.00	0.00
0.50 N H_2SO_4	7.75	0.50	0.25	0.00	0.00
1.00 N H_2SO_4	0.25	0.00	0.00	0.00	0.00

It will be noted from the table that as the moisture content of the sand increased the emergence of flies was correspondingly reduced. It was noted that in the saturated jars only those larvae pupating on top of the sand produced flies. Pupae buried under 1, 2 and 3 inches of saturated sand (400 at each level) failed to produce flies, while good emergence was secured in the controls.

CONCLUSIONS.—Larvae of *Cochliomyia*

* These media were modifications of those described by R. Melvin, and R. C. Bushland, 1936. A method of rearing *Cochliomyia americana* C. & P. on artificial media. Diptera. U. S. D. A. Bur. Ent. and Plant Quar., Mimeo. Cir. ET-88.

americana C. & P. can withstand greater concentrations of potassium hydroxide than of sulfuric acid, but their great tolerance to both chemicals indicates in general that, in nature, the alkalinity and acidity of the soil are factors of negligible importance on the emergence of adults.—3-5-38.

An Unusual Type of Top-Kill of Ponderosa Pine

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During 1935 an unusual type of insect attack on the tops of ponderosa pine trees was prevalent in several forested areas in California. In most of the areas in which the injury was noted in 1935, little or no new injury could be found in 1936. However, a limited amount of the same type of damage was seen in several new areas. Typical examples of the damage are illustrated in fig. 1, which shows injured trees on a cut-over area near Whitehorse on the Modoc National Forest. Two species of *Pityophthorus* seemed to be primarily responsible for the injury.

DISTRIBUTION OF THE INJURY.—The injury was first noticed in 1935 near Whitehorse. No new attacks were found in that area in the following year. The top-killing was not confined to cut-over stands, as it also occurred in virgin timber nearby. Similar injury was observed in virgin stands on the Plumas National Forest in 1935. In 1936 a considerable amount of the same type of top-killing was seen on recently cut-over lands in Squaw Queen Valley on this forest. The stands had been logged late in 1935, or were in the process of being logged during 1936. A small amount of injury was noted in 1936 in second-growth stands along the road from Marysville to Camptonville.

In 1935 top-killing was very prevalent in some stands on the Stanislaus National Forest. J. E. Patterson of the Berkeley laboratory, Bureau of Entomology and Plant Quarantine, observed the injury and collected specimens from cut-over lands near Pinecrest on that forest. W. W. Wagener, of the Office of Forest Pathology, Bureau of Plant Industry, also collected specimens from trees in the vicinity of Jenness Mill on the same forest. Although Mr. Patterson observed some recently injured trees in the same general area in 1936, they were much less abundant than during the previous season.

G. R. Struble of the Berkeley laboratory reported that 1935–36 overwintering broods of *Pityophthorus* were present in two-thirds of the upper crown of a ponderosa pine that was attacked by 1936 broods of the western pine beetle, *Dendroctonus brevicomis* LeC. In his opinion the *Pityophthorus* attack was primary and preceded attacks by the other species.

A similar type of injury was observed in parts of the Sierra National Forest in 1936. Examination of a tree in which the killing had advanced for some distance down the bole revealed the presence of broods of *Ips confusus* (LeC.) in the top. In other trees, in which the damage was confined to the extreme tip, it is probable that *Pityophthorus*, and not *I. confusus*, was responsible for the injury.

CAUSE OF THE INJURY.—Samples of infested material were obtained by felling injured trees, and attempts were made to diagnose the conditions that induced the infestation. Examination of the infested trees showed that species of *Pityophthorus* were, with few exceptions, the only ones concerned. Specimens sent to M. W. Blackman, then of the Division of Forest Insect Investigations, Washington, D. C., were determined by him as *P. confinis* LeC. and *P. confertus* Sw.

So far as is known, these species have not been recorded heretofore as causing this type of injury. However, observations have indicated that the damage, although perhaps more prevalent and widespread during 1935 and 1936, is not of rare occurrence. Trees having small stag tops were seen in several of the infested areas, and apparently these top injuries are the result of old *Pityophthorus* attacks.

HABITS OF THE SPECIES CAUSING THE DAMAGE.—*P. confinis* has been reported by Blackman (1928) to occur in seven western states and in British Columbia. He lists ponderosa, Jeffrey and Coulter pines as hosts and indicates that pon-