Concern about persistence of synthetic pesticides in soil and the environment in general has been greater where chlorinated hydrocarbon compounds have been involved than where organophosphorus pesticides have been used. This is understandable, inasmuch as organophosphorus compounds generally degrade more rapidly in the environment. Most of the research concerning degradation or disappearance of organophosphorus compounds from soil has involved relatively low initial levels of pesticide resulting from conventional applications of the compounds for insect control. At these levels the degradation of organophosphorus compounds has generally been much more rapid than with chlorinated hydrocarbon compounds (1,2). Recently Stewart et al. (3) found traces of parathion in soil 16 years after the last application. The finding at this laboratory (4) that spillage of emulsifiable concentrate parathion and azinphosmethyl on soil at spray machine fill sites, air application flight strips, and other locations may be a hazard to children because of the presence of persistently high concentrations of the pesticides, has prompted our further investigation into the problem of persistence of organophosphorus compounds in soil. The purpose of the present study was to determine the disappearance of parathion residues in soil following topical applications of the compound. The results are intended to have application to problems related to waste pesticide disposal, of leaching, and of degradation or disappearance of parathion in the environment, as well as to the problem of hazard to children who may come in contact with contaminated spillage areas.

Materials and Methods

The experiment involved treatments of field soil plots using three liquid parathion concentrations and two different formulations. Treatments were: (a) undiluted commercial grade 45.6% liquid emulsifiable concentrate, (b) conventional dilute spray for orchard use prepared from water-wettable powder and containing 0.03% parathion (referred to as 1X concentration), (c) a dilute spray similar to (b) except prepared from emulsifiable concentrate, (d) a spray mixture of the type commonly used for semi-concentrate spray applications prepared from water-wettable powder and containing 0.24% parathion (8X—eight times the normal 1X
concentration), and (e) a spray mixture similar to (d) except prepared from emulsifiable concentrate. The undiluted emulsifiable concentrate treatment was included in order to simulate spillage of concentrate pesticide and the more dilute concentrations were used because of the occasional practice of dumping various quantities of unused liquid spray formulation from spray machines onto the ground after finishing a particular spray operation. The undiluted emulsifiable concentrate and 8X treatments were replicated four times in each of three field plots. The 1X treatments were replicated four times in two field plots.

All experimental plots were subjected to the natural elements such as rainfall (average approximately 10 inches per year), sunlight (over 275 days during each year), and relatively high maximum temperatures (over 90°F for an average of 14 days each summer). The plots were covered with snow for approximately 2 months of each year. All three plots were sandy loam soil; however, plot 3 was on the verge of being classed as loamy sand. Plot 1 soil contained 11.2% clay, 34.2% silt, 54.6% sand, and 2.5% organic matter. The pH ranged from 4.4 to 5.4 with a mean of 4.7. This plot was subjected to sprinkler irrigation for a 24-hour period each 2 weeks during the summer season. The other two plots were not irrigated. Plot 2 soil contained 10.2% clay, 29.0% silt, 60.8% sand, and 3.4% organic matter. The pH ranged from 6.7 to 7.4 with a mean of 7.1. Plot 3 soil contained 6.0% clay, 26.0% silt, 67.3% sand, and 1.0% organic matter. The pH ranged from 6.6 to 7.8 with a mean of 7.3.

Metal frames 12-inches square were used to outline the individual soil test areas within each experimental plot. These were left in place for the duration of the experiment. The frames were pressed into the soil so that when 2 quarts of liquid parathion formulation were applied topically within the frame, a pool approximately 3/4-inch deep was formed before the material soaked into the soil. Samples of soil from two depths (0-1 in. and 1-3 in.) were taken 1 day following application and at intervals thereafter up to 5 years. At the 6th-year period two soil test areas were sacrificed and four replicate samples taken from each area at different depths in increments of 3 inches down to the 24-inch level.

Soil samples to the 3-inch level in all plots were taken by use of a cork borer tube which was cleaned after collection of each sample. Care was taken to minimize cross contamination between soil samples at different depths. However, it was difficult to avoid some cross contamination, due to limited surface area of test plots, especially after the 3rd year of sampling. It was felt that cross contamination of samples below the 3-inch depth was negligible because samples in this area were taken by