liter. Under similar conditions, except for an exposure period of 2 hours, 2.79 and 4.40 mg. per liter of *Ethide* were calculated as the dosages required to give 50 and 99 per cent kill, respectively, of the firebrat.

Ethide was found to exhibit a delayed action which was more pronounced at the lower concentrations. No difficulty was experienced in getting the material to volatilize at the concentrations employed throughout the experiment.—2-15-43.

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The Action of Bean Leaves Against the Bedbug

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It is the practice in the Balkan countries to exterminate bedbugs (*Cimex lectularius* L.) by spreading common bean leaves on the floor of infested rooms. According to Bogdandy (1927), the bedbugs crawl onto the leaves at night, and the next morning the leaves with the bugs on them are removed and burned. He states that the bugs sometimes completely cover the leaves, and that in a badly infested room he has removed 2.25 pounds of them. The bedbugs appeared to be in a dazed condition for they reacted very sluggishly upon mechanical stimulation and could hardly be induced to move from the leaves.

From this report the question naturally arises: Is there a chemical present in bean leaves which attracts and possibly dazes the bedbug? If so, it might be useful against this insect, the control of which is especially important in wartime since infestations are liable to develop in soldiers' barracks, air-raid shelters, and similar places. The action of bean leaves on the bedbug was therefore studied prior to a possible investigation of the attractant chemical, if any was found.

After preliminary studies a series of 7 tests were made, in which 24 to 273 bedbugs (average 110) were confined in an enameled pan 9 inches in diameter on which were spread 3 or 4 freshly picked bean leaves, *Phaseolus vulgaris* L. and an equal number of squares of white blotting paper of the same area as the leaves. Blotting paper is regularly used in rearing bedbugs (Woodbury *et al.*

FIG. 1.—Live adult bedbug trapped on bean leaf. Note abnormal position of legs. ×10.

[1] The writer is indebted to H. L. Haller for calling attention to Bogdandy's report, to J. G. Pratt for making the photographs, to Carlo Zeimet for helping with the translations, and to S. F. Blake for suggesting types of plants.

1939, Campbell *et al.* 1941), and once placed on it the insect rarely leaves except to feed. The pan was covered loosely with a similar pan to keep out light, and the insects were allowed to remain overnight. Upon examination the next morning on an average 32 per cent of the bedbugs (ranging from 12 to 62 per cent) were found on the bean leaves; the remainder had gathered on the under side of the blotting paper. Other types of foliage were also tested, but they gave negative results.

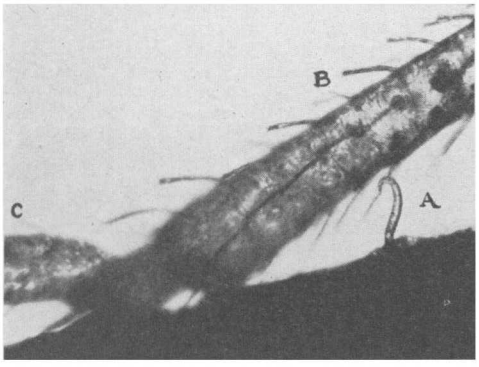

FIG. 2.—*A*, Hooked hair present on bean leaf; *B*, tibia of bedbug leg; *C*, tarsal segments of bedbug leg. ×200.

This rough test at first seemed to indicate that bean leaves might have some attractant powers, but on closer observation it appeared that the bedbugs were trapped in some way on the leaf. Figure 1 shows that the legs of the bedbug caught on the leaf are stretched out in an abnormal position. Most bedbugs at rest tuck the lower parts (tibia, tarsi, and claws) of the second and third pairs of legs under or alongside the abdomen. Under higher magnification, as shown in figure 2, the bean leaves were found to have small hairs, with a sharply pointed hook at the distal end, on both the upper and the lower surface of the leaves. Usually the tarsal segments or the claws of the insect's leg are caught by the hooks, and in some cases the sharp point of the hook appeared to be embedded in the outer covering (cuticle). The hooks are strong, and when a leg is caught the insect usually struggles vigorously so that other legs become entangled.

Bogdandy states that the bean leaves should be placed with the under side up. In the present tests the majority of the insects were caught on the under surface, and examination revealed more hooked hairs on this side.

Apparently the bedbug walks up onto the bean leaf simply by chance and walks off it just as casually unless a leg becomes entangled in the hooks. There appears to be no attractant action.

The fact that some bedbugs remained on the exposed surface of the leaf, rather than hidden underneath, where they would normally be found, is another indication of a restraining, trapping effect. Kemper (1936) stated that Bogdandy was mistaken in his observation that bean leaves have an attractive action. Kemper believed that the presence of numerous bedbugs on bean leaves may be explained simply by their habit of seeking a protected place. However, the present results do not support that explanation, since the bedbug would normally seek protection on an unexposed surface.

This trapping action will also explain, but not support, Bogdandy's statement that the insect appeared dazed and could hardly be induced to move. According to further observations, the insect, once caught, rarely frees itself, except by molting, and the cast skin remains caught in the hooks. There seemed to be no dazing effect, for after bring freed of the hooks the insects moved off rapidly and appeared quite normal. The fact that trapped insects remained alive for some time and finally starved to death also indicates the absence of any toxic effect.

Once several insects were caught on a leaf, others came and rested among those that were trapped. This was apparently due to the herding, or grouping, habit of the bedbug.

Only two varieties of bean leaves were tested, Early Bountiful variety of bush beans and an undetermined variety of kidney beans. In future tests it may be desirable to try a wide selection for possible differences in efficiency.

Tests were also made with a number of other types of plant foliage, including alfalfa, coleus, chrysanthemum, fuchsia, and white clover, but the results were negative. None of these plants had the hooked hairs.[1]

[1] These hooked hairs on beans have been observed by Poos and Smith (1931) to have an adverse effect on the young nymphs of *Empoasca fabae* (Harr.). They report that the young nymphs were frequently impaled on the hooks of bean (Stringless Greenpod). They did not observe this action with some other host plants, none of which had hooked hairs.

Tests were also made with the seed pod of the common weed tick trefoil, or beggar's-lice (*Desmodium* sp.), which is covered with small hooked appendages similar to but larger than those on bean foliage. The bedbug can also be trapped on the hooks of this plant (Fig. 3).

The practicability of the use of bean leaves in bedbug control has not been tested. Bogdandy states that all the bedbugs were destroyed after three or four renewals of the bean leaves. It seems probable that large populations of bedbugs can be greatly reduced in this way, and the method may be worth a trial where no suitable insecticides are available. However, there would be no effect on the eggs, and complete extermination by this method seems very questionable.

SUMMARY.—To find out why bean leaves are used in the Balkan countries for trapping bedbugs (*Cimex lectularius* L.), bedbugs were confined with bean leaves overnight in the laboratory. The results indicate that bean leaves have no attractant action, but they do act as traps by means of the small hooked hairs present on both sides of the leaves. The legs of the insect become entangled in these hooks. The seed pod of the common weed tick trefoil exerts a similar action. Other types of foliage that had no hooked hairs gave negative results.—2-22-42.

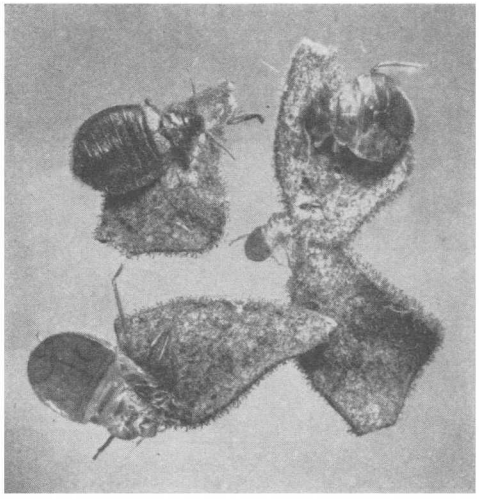

FIG. 3.—Bedbugs trapped in hooks on seed pod of tick trefoil. Note cast skins left by bedbug in freeing itself from the hooks.

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Lures Attractive to the Apple Maggot[1]

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The studies of McPhail (1939) on protein lures attractive to flies in the genus *Anastrepha* have stimulated a lively interest in the use of baits as attractants for other trypetid flies. Dean (1941) reported on the efficiency of a number of decomposing protein lures which were used to attract the apple maggot, *Rhagoletis pomonella* Walsh. Boyce & Bartlett (1941) applied some of McPhail's results in trapping experiments with the walnut husk fly *Rhagoletis completa* Cress. The particularly encouraging results of the walnut husk fly investigation prompted a test in Minnesota of the most promising materials as lures for the apple maggot. A preliminary study was completed in 1941, Benjamin and Hodson (1942), in which several decomposing protein baits, including the so-called McPhail bait, were found to be much inferior to the glycine-sodium hydroxide bait used by Boyce & Bartlett.

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[2] This investigation was carried on in cooperation with A. G. Ruggles, State Entomologist of the State Department of Agriculture, Dairy and Food. Merle W. Wing, of the State Entomologist's Office, conducted most of the field work.