

**SOME EXPERIMENTS WITH CERTAIN LIQUID  
INSECTICIDES IN HOUSES INFESTED WITH  
THE BED-BUG, *CIMEX LECTULARIUS* L.**

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(With 5 Figures in the Text)

CONTENTS		PAGE
Introduction . . . . .		462
Materials . . . . .		463
Treatment of houses with liquid insecticides:		
Experimental method . . . . .		463
Experiments in houses under a demolition order . . . . .		465
Experiment in a larger house . . . . .		471
Treatment of an occupied house . . . . .		471
Effect of insecticides on the fabric of the buildings . . . . .		472
Discussion . . . . .		472
Summary . . . . .		472
Acknowledgements . . . . .		473
References . . . . .		473

### INTRODUCTION

LIQUID insecticides which have no residual effects appear to be of little use against the bed-bug because it is usually in hiding during the time when the sprays are used. For this reason, I think, other methods of disinfection have been more popular (cf. Roberts & Dick, 1935).

Potter (1938) has shown that insects which settle on surfaces sprayed with a liquid consisting of pyrethrum in a heavy white oil are incapacitated by the action of the film of insecticide. I have found (unpublished work) that surfaces sprayed with a liquid consisting of pyrethrum in a light oil appear to be equally effective against other insects. Recently, Potter & Musgrave (1940) have shown that an organic thiocyanate,  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether has a marked toxic effect on the eggs of the bed-bug either as a contact spray, a vapour, or a film on a surface sprayed with a liquid consisting of the thiocyanate in a heavy white oil. No experiments have yet been done to see if the thiocyanate in a light oil forms an effective film. Callaway & Musgrave (1940) compared the thiocyanate with a number of other compounds and found it to be the best under the conditions employed.

This paper describes some experiments in which the thiocyanate was used in some bug-ridden houses. Fifteen houses under a demolition order and some others were available for the tests. Since these tests the thiocyanate has been

used in commercial practice. In view of the difficulties often encountered in fumigating bug-ridden property the possibility of using liquid insecticides cannot be overlooked.

#### MATERIALS

The thiocyanate is marketed as a 50% solution of  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether or normal butyl-carbitol-rhodanate, under the name of Lethane 384. According to Prof. Cameron (personal communication; see also Cameron, Doniger & Hughes, 1939), of University College Hospital Medical School, there is no danger to health when this substance is used in ordinary ways in solutions up to 3% of the thiocyanate in some diluent. In addition to the thiocyanate, solutions of pyrethrins have been used. The following were diluents or carriers: Shell Oil No. 24210, an oil of high viscosity and low volatility which leaves a good film; Shell's Odourless Distillate, an oil of the highly refined kerosene type of fairly high volatility; Shell's White May Kerosene, a less highly refined kerosene; and the Anglo American Co.'s "300 burning oil" which appeared to be a rather crude kerosene of medium volatility. A mixture of the oil 24210 and Odourless Distillate was also used. The insecticides were tested singly and mixed and with and without deodorants.

#### TREATMENT OF HOUSES WITH LIQUID INSECTICIDES

##### *Experimental method*

The insecticides were sprayed on to the internal fabric of the buildings, special attention being paid to cracks and other hiding places. A heavier application was given to the upper rooms and stairs of the houses than to other parts; sometimes the lower rooms were scarcely sprayed at all. In most instances small quantities of insecticides were used. Where the wallpaper was very loose it was torn off; occasionally skirting boards were eased or removed and in two houses (nos. 6 and 10) some of the plaster was removed. In some experiments a small petrol air compressor was used to supply air to oil or paint spray guns. A large gun (Fig. 1) and a small (Fig. 2) were available. The "Phantomyst" apparatus, a patented device for obtaining a very high degree of atomization, worked by the compressor, was also used. Good results were obtained with the air compressor, but it was available for only a short time, and it seems to be rather an expensive method for use by local authorities. It was therefore necessary to try other methods. A trial of the "Merryweather" foot-pump sprayer suggested that this would be too wasteful. The most economical method seemed to be to use an ordinary "hand sprayer" similar to that used by horticulturalists and giving a continuous spray. In the earlier experiments the men applying the insecticides wore gas masks which they afterwards dispensed with. It is probably advisable to wear a simple mask of some kind when spraying the thiocyanate in a kerosene base as it is pungent. The pungency seemed to vary with the mode of application and with the oil used as diluent.

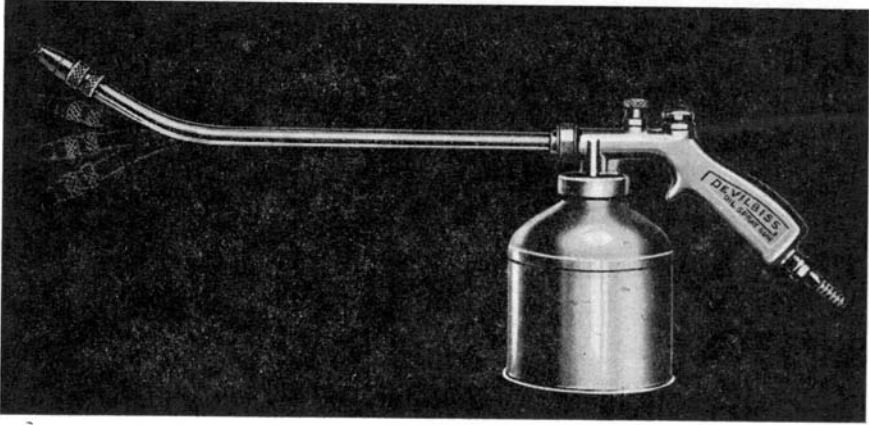


Fig. 1. A large gun.



Fig. 2. A small gun.

Some method of estimating the number of bugs killed by the spraying had to be devised as it was found that mere inspection of a house was unsatisfactory. An attempt was made to trap bugs by leaving a rabbit in a hutch, surrounded by sticky banding, as a bait, but this was not a success. In later experiments it was decided to make a careful examination of each house after spraying, and by crawling round the rooms and collecting the insects it seemed possible to obtain a reasonably accurate measure of the numbers present. Special attention was given to the upper rooms and staircases. Dead bugs were collected into tubes, but the living bugs were left in position. In the five houses utilized in the earlier experiments, and in house no. 6, it was found impracticable to collect all the bugs seen. This method of estimating the kill has a large personal error, depending on the heat of the day and the condition of the observer; on some occasions a torch was used. At a later date some houses were carefully examined both before and after spraying and others were used as controls or checks to determine any mortality from causes other than the insecticide.

*Experiments in houses under a demolition order*

These houses, which were unoccupied when treated, were all of the same general plan, but of two slightly different types. Nos. 1–7 and 10–15 were of one type. The front door opened on to a sitting room and this communicated at the back with a small kitchen-scully which opened on to a small yard, containing the W.C.'s., common to a group of houses. From each kitchen a short flight of stairs led to two bedrooms. Under the stairs was a space, usually used as a coal hole but sometimes containing bedsteads or mattresses and debris.

Houses nos. 8 and 9 had "front" and "back" doors on the same wall. The stairs ascended from the sitting room which was at the side of, instead of the front of, the kitchen. The houses were arranged in an L-shape (Fig. 3). There appeared to be a common roof space for nos. 1–7 which was entered from no. 1. I did not find an entrance to the other attics.

The experiments will be described by referring to each house in turn. Because it was very difficult when crawling round a room to count accurately the number of live and dead bugs observed and collected, all the counts over 20 have been transcribed to the nearest ten. For example, counts of 21–24 are expressed as 20; counts of 25–29 as 30; those of 200–204 as 200 and so on. Nearly all the bugs collected in the houses were preserved in tubes with alcohol with a label noting their origin. It was thus possible to keep some check on the total number of insects from each house by accurately counting the preserved bugs in the laboratory.

In the laboratory counts, the bugs have been classified as adults, nymphs and bits. "Bits" were any incomplete portions of reasonable size, e.g. head and thorax, abdomen or part, or entirely legless bugs; antennae and legs, etc.,

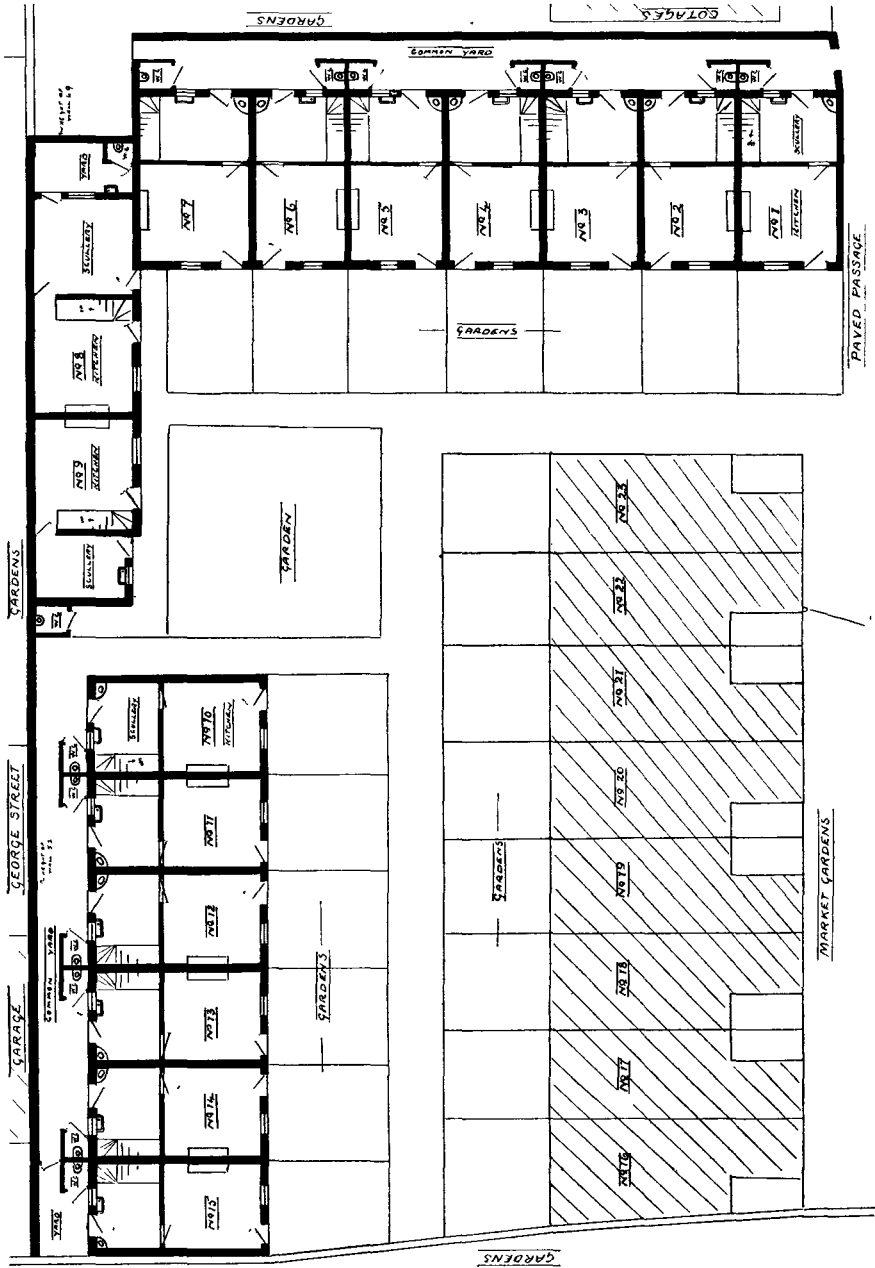


Fig. 3. Plan of the houses described.

were not counted as bits. It was noticed while counting that some of the bugs were hard and black as if, perhaps, they had been diseased or abnormal in some way; others had black legs. I have no satisfactory explanation of these peculiarities. There were not many of these unusual bugs in any house.

*House No. 1.* Condition: This house was filthy; the bottom of the staircase had been removed and an old mattress and other rubbish had been left in the coal hole. This was one of the first houses to be sprayed and the technique was not fully developed. The house was known to be badly bug-ridden.

18. v. 38. The interior was treated with about 1 gal. of approximately 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Shell Oil 24210. A large and a small spray gun were used; both were supplied with air from a small petrol compressor. The "Phantomyst" apparatus was also used.

20. v. 38. Examined: Many dead (hundreds), but the kill was not complete.

19. viii. 38. Many living bugs.

8. ix. 38. Many living bugs.

It was decided not to use this house as an experiment as the dirt and the lack of the first five stairs made spraying and the estimation of the kill very difficult.

*House No. 2.* Condition: Very dirty and in poor structural condition; wallpaper loose. The house was one of the earlier ones to be sprayed before the technique had been fully elaborated.

18. v. 38. Sprayed with about 1 gal. of approximately 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in White May Kerosene with a large and small gun from the compressor. The "Phantomyst" apparatus was also used.

15. vi. 38. Sprayed with about 1 gal. of approximately 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in White May Kerosene by means of the "Merryweather" foot pump.

17. vi. 38. Carefully examined: many dead; no living bugs seen.

24. vi. 38. 150 collected; two living bugs seen and left.

19. viii. 38. No living bug seen.

8. ix. 38. A few living bugs seen.

Laboratory count: 122 adults, 11 nymphs, 12 bits. Total 145.

*House No. 3.* Condition: Very dirty, though in a reasonable structural condition. This house was sprayed early in the work.

23. v. 38. Sprayed with about 1 gal. of 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Odourless Distillate using two guns from the compressor.

15. vi. 38. An exactly similar application was given.

17. vi. 38. Many dead; three living bugs seen.

11. viii. 38. 220 dead collected; no living bugs seen.

8. ix. 38. One living bug.

Laboratory count: 192 adults, 18 nymphs, 13 bits. Total 223.

*House No. 4.* Condition: Recently vacated, clean and well scrubbed. The house appeared to be in good structural condition. There seemed to be too few bugs in the house to justify a spraying experiment.

11. vii. 38. Two dead collected; no living bugs seen.

26. vii. 38. No dead collected; one living bug seen.

23. ix. 38. No dead collected; no living bugs seen.

*House No. 5.* Condition: The structural state was reasonable, but the house was rather dirty.

20. v. 38. Sprayed with about  $\frac{3}{4}$  gal. of 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Shell Oil 24210, deodorized. The liquid was sprayed with a large gun supplied with air from the petrol compressor. The lower front room received a particularly small dose.

27. vi. 38. Sprayed with about 1 gal. of 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Shell Oil 24210 with a hand sprayer and guns from the compressor.

19. viii. 38. Eighty dead collected; one living bug seen.

8. ix. 38. A few living bugs seen.

Laboratory count: 55 adults, 17 nymphs, 8 bits. Total 70.

These five houses may be regarded as forming the preliminary experiments. The remainder of the work was more detailed and careful with regard to the estimation of the kill obtained.

*House No. 6.* Condition: This house was very dirty and in great need of structural repair. Even a casual glance suggested that the house was heavily infested. There were cracks nearly 2 in. wide in some parts of the walls and some of the skirting board was loose. The two bedrooms each contained parts of two bedsteads which were heavily infested.

During the experiments on this house sections of the plaster of the walls were removed from the underlying laths, and in one place a live nymph was found between the plaster and the laths, well within the fabric of the wall.

The trap with the rabbit hutch surrounded by a sticky band (see p. 465) was tried in this house. Only a few nymphs were found in the band.

20. v. 38. Sprayed with  $\frac{3}{4}$  gal. of 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Odourless Distillate by means of the small gun from the compressor.

15. vi. 38. Sprayed with 1 gal. of a similar solution by means of two large guns supplied with air from the compressor.

17. vi. 38. 810 dead collected; 17 living bugs seen and left.

25. vi. 38. 300 dead collected; 22 living bugs seen and left.

27. vi. 38. Sprayed with 1 gal. of 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Odourless Distillate with the large guns supplied with air from the compressor.

1. vii. 38. 330 dead collected; 12 living bugs seen and left.

8. vii. 38. 60 dead collected; 5 living bugs left.

11. vii. 38. 40 dead collected; 5 living bugs left.

19. vii. 38. 100 dead collected; 13 living bugs left.

25. vii. 38. 120 dead collected; 50 living bugs seen and left.

26. vii. 38. Sprayed with 1 gal. of 2%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Odourless Distillate by means of a hand gun.

5. viii. 38. 390 dead collected; 40 living bugs seen, of which 30 were left.

12. viii. 38. 110 dead collected; 13 living bugs seen and left.

17. viii. 38. Sprayed with 1 gal. of 3%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in 300 Burning Oil, deodorized. Applied by means of hand sprayers.

19. viii. 38. 60 dead collected; 1 living bug seen and left.

8. ix. 38. 90 dead collected; 2 living bugs seen and left.

23. ix. 38. Many dead collected, no living bugs seen. Total of dead bugs = 2400.

Laboratory counts 1378 adults, 601 nymphs, 215 bits = 2194 and 1 small beetle.

Because of the vast number of bugs in this house it was impracticable to collect every bug at each survey, but most of them were collected.

*House No. 7.* Condition: The structural state of this house appeared to be quite good, it was clean and the wallpaper was well pasted on; the rooms were light.

20. v. 38. Sprayed with 1 gal. of 0.13% pyrethrins in Shell Oil 24210 by means of a large gun from the air compressor.

14. vi. 38. 4 dead collected; 2 living bugs seen.

15. vi. 38. About 30 bugs, mostly nymphs, were liberated.

17. vi. 38. 4 living bugs seen.

25. vi. 38. No bugs seen.

11. vii. 38. 4 dead collected; no living bugs seen.

15. vii. 38. Sprayed with 1 gal. of 0.13% pyrethrins in Shell Oil 24210 with the hand sprayer and a sprayer usually used for distributing formalin. There was a perceptible smell of formalin.

19. vii. 38. 11 dead collected; no living bugs seen.

12. viii. 38. 7 dead collected; no living bugs seen.

19. viii. 38. 3 dead collected; 2 living bugs seen and left.

8. ix. 38. 3 dead collected; 1 living bug seen.

23. ix. 38. 2 dead collected; no living bugs seen. Total of dead collected = 34.

Laboratory count: 22 adults, 4 nymphs, 5 bits, 1 flea = 31 and 1 flea.

*House No. 8.* Condition: This house appeared to be in good structural condition; it was clean and all the rooms except the kitchen-scullery were light. No sign of bugs was seen. The house was not sprayed, and no bug was ever seen in it.

*House No. 9.* Condition: This house was in reasonable structural condition, but it was dirty. All the rooms were fairly light. The house appeared to be infested.

9. vi. 38. Sprayed with 1½ gal. of 0.065% pyrethrins and 1% β-butoxy-β'-thiocyanodiethylether in White May Kerosene, applied by means of a large gun supplied with air from the compressor.

14. vi. 38. 10 dead collected; no living bug seen.

17. vi. 38. 10 dead collected; 1 living bug seen and left.

8. vii. 38. 2 dead collected; no living bug seen.

25. vii. 38. 7 dead collected; 1 living bug seen and left.

19. viii. 38. 2 dead collected; no living bug seen.

8. ix. 38. No dead collected; no living bug seen.

Laboratory count: 24 adults, 2 nymphs, 2 bits = 28 bugs.

*House No. 10.* Condition: This house was in bad structural condition and was very dirty; the rooms were rather dark as there was dark paint on the walls. A heavily infested bedstead was found in the kitchen under the stairs. The kitchen-scullery of this house was usually surveyed as well as the upper storey.

9. vi. 38. Sprayed with 1½ gal. of 0.13% pyrethrins in Shell Oil 24210 by means of a large gun supplied with air from the compressor.

14. vi. 38. 120 dead collected; 3 living bugs seen and left.

17. vi. 38. 140 dead collected; 3 living bugs seen and left.

1. vii. 38. Sprayed with 1 gal. of 0.13% pyrethrins in Shell Oil 24210 by means of a sprayer usually used for distributing formalin and the hand sprayer.

8. vii. 38. 18 dead collected; 5 living bugs seen and left.

8. vii. 38. 7 bugs marked with white paint were liberated and 2 living bugs already present were similarly marked.

19. vii. 38. 160 dead collected (including 1 marked); 5 living bugs seen and left (including 2 marked).

25. vii. 38. 40 dead collected (including 1 marked); no living bugs seen.

5. viii. 38. 30 dead collected; 1 living bug seen and left.

12. viii. 38. 15 dead collected; 1 living bug seen and left.

19. viii. 38. 4 dead collected; no living bugs seen.

8. ix. 38. 8 dead collected; no living bugs seen.

Only 4 of the 9 marked bugs were recovered. Total number of dead bugs = 535.

Laboratory count: 84 nymphs, 391 adults, 39 bits = 514.

*House No. 11.* Condition: Structurally this house was fairly sound. It was dirty and a lot of old bedding, etc., had been left in the coalhole and at the bottom of the stairs.

23. vi. 38. Sprayed with 1½ gal. of 3% β-butoxy-β'-thiocyanodiethylether in Odourless Distillate with the hand sprayer.



24. vi. 38. 140 dead collected; no living bugs seen.  
 1. vii. 38. 50 dead collected; 1 living bug seen and left.  
 8. vii. 38. 16 dead collected; 3 living bugs seen and left.  
 26. vii. 38. Sprayed with 1 gal. of 3%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Odourless Distillate with the hand sprayer.  
 5. viii. 38. 40 dead collected; 3 living bugs seen and left.  
 12. viii. 38. 20 dead collected; 2 living bugs seen and left.  
 17. viii. 38. Sprayed with 1 gal. of 3%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in Odourless Distillate by means of the hand sprayers.  
 19. viii. 38. 30 dead collected; no living bugs seen.  
 8. ix. 38. 14 dead collected; no living bugs seen.  
 Total of dead collected = 310.  
 Laboratory count: 220 nymphs, 91 adults, 40 bits, 1 Dermestid larva = 351 and 1 Dermestid larva.

*House No. 12.* Condition: This house was in fairly good structural condition but was dirty and rather dark. For some time it was used as a control.

11. vii. 38. 13 dead collected; 9 living bugs seen and left.  
 26. vii. 38. 5 living bugs seen and left.  
 5. viii. 38. 20 dead collected; 14 living bugs seen and left.  
 12. viii. 38. 12 dead collected; 7 living bugs seen and left.  
 19. viii. 38. 18 dead collected; 8 living bugs seen and left. 14 dead were found on one window ledge.  
 8. ix. 38. 5 dead collected; 4 living bugs seen and left.  
 16. ix. 38. Sprayed with 1 gal. of "300 burning oil" by means of the hand sprayer.  
 23. ix. 38. 17 dead collected; 1 living bug seen and killed. Total dead collected: 85.  
 This house also contained a number of *Niptus hololeucus*. Laboratory count: 9 nymphs, 42 adults, 31 bits.

The number of bugs found in house No. 12 is shown graphically in Fig. 4.

*House No. 13.* Condition: The house was dark and fairly dirty but appeared to be in fairly good structural state. It seemed to be heavily infested.

The house was sprayed with a made-up commercial insecticide. Unfortunately, subsequent examination showed that the house contained an exceedingly small population of bugs (seven) so that the results could not be regarded as significant; they have therefore not been quoted.

*House No. 14.* Condition: The structural state of this house appeared to be fairly good, but the rooms were rather dark. The house was fairly dirty.

26. vii. 38. The floors were swept in order to remove any dead bugs which might have been present.  
 29. vii. 38. The floors were swept again. The house was then sprayed with 1 gal. of 3%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in "300 burning oil" by the hand sprayer.  
 5. viii. 38. 30 dead collected; no living bugs seen.  
 12. viii. 38. 30 dead collected; no living bugs seen.  
 19. viii. 38. 9 collected; no living bugs seen.  
 8. ix. 38. 7 dead collected; no living bugs seen.  
 Total dead collected: 76.  
 Laboratory count: 45 nymphs, 8 adults, 15 bits = 68.  
 The number of bugs found in house No. 14 is shown graphically in Fig. 5.

*House No. 15.* This house was in fairly good structural state; it seemed bright and clean. No sign of bugs was seen in this house on any occasion when it was examined. It was not sprayed.

When these houses (1-15) were demolished during the winter all woodwork that appeared to be infested was burned by the contractors conducting the demolition. The site was visited but no live bugs were seen although there were plenty of cast skins and debris. Some eggs which appeared not to have been hatched were found; they did not hatch after a fortnight in an incubator at 32-37° C.

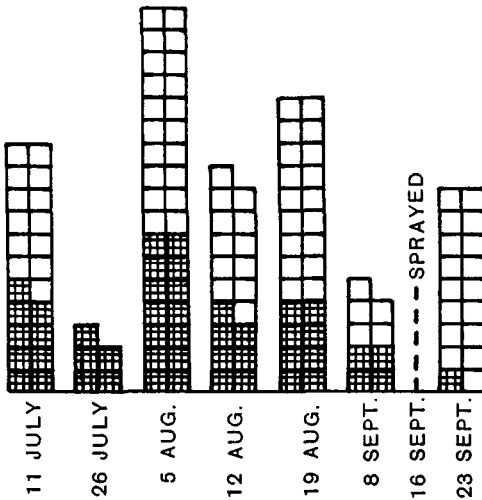


Fig. 4. House no. 12.

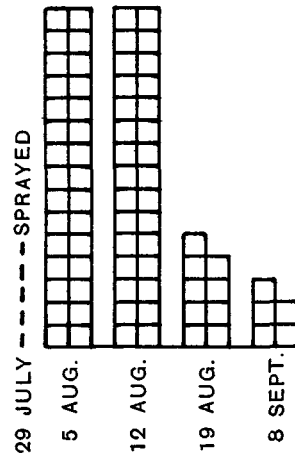


Fig. 5. House no. 14.

The hatched squares represent living bugs seen and the plain squares dead bugs collected. Each square represents one bug.

#### *Experiment in a larger house*

This house was semi-detached and had been recently vacated; it was said to be badly infested. There was a hall, a front room and a kitchen-scully. The stairs ascended to a small landing on to which opened three bedrooms, a bathroom and a W.C. There was a roomy attic, easy of access. From the point of view of bug disinfection the house was badly constructed as there was a lot of harbourage in the ceilings, and much of the beaver board used in its construction had warped and left spaces in which the bugs could hide. The house was considered to be badly infested by the local Public Health Authority and to be a difficult house to disinfect.

The house was treated on 11 November 1938 with a big dose of approximately 3%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether, deodorized, in three different carriers. The carrier chiefly used was Odourless Distillate, but the attic was treated with "300 burning oil" and parts of the kitchen-scully with  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in the Shell Oil 24210. In all, about 6 gal. were used. The material made up in Odourless Distillate was applied with the "Merryweather" foot pump, the material sprayed in the attic and made up in 300 burning oil was sprayed with an ordinary garden syringe and the Shell Oil 24210 material was sprayed with the hand sprayer. The disinfection was carried out in the presence of an audience of specialists, which made the work more difficult. When the house was examined 3 days later one living and many dead bugs were found.

#### *Treatment of an occupied house*

An occupied house was used in one simple experiment on 16 December 1938. The house was similar in size and plan to nos. 1-8 and was very dark and dirty inside; in one of the bedrooms there was a layer, about 2 in. thick, of dust and fluff behind one of the articles of

furniture. The house appeared to be infested with about two or three hundred bugs. Although the bedding had been removed for disinfestation elsewhere, the two small bedrooms were almost blocked with furniture when the insecticide was applied. There was much loose wall-paper and dirt in both and one contained a number of ornaments in addition.

The upper rooms and staircase were sprayed with just under 1 gal. of approximately 2½%  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether in a mixed carrier consisting of 15% of Shell Oil 24210 and 85% Odourless Distillate. The insecticide was deodorized. The spraying was little more than cursory.

Although many bugs were killed the eradication was not complete. The occupier was apathetic towards the disinfestation and made little effort to help. When the bedding had been returned, she was discovered putting disinfested sheets back on to the bed without brushing the killed bugs off the bed-frame. The bedroom was still dirty.

#### *Effect of the insecticides on the fabric of the buildings*

The only instance in which damage was reported must be neglected as the situation was complicated by the subsequent application of another and different insecticide. The use of the heavy oil 24210 might be objectionable in some situations owing to the film it leaves.

Except for this film no damage was noticed in the other houses. Odourless Distillate is said to be harmless to fabrics and it would seem that such a highly refined, quickly evaporating oil is unlikely to do any damage. No soft furnishings were sprayed.

#### DISCUSSION

The method used to estimate the number of bugs killed by the treatment gave only approximate figures, and it was impossible to ascertain whether the houses had been freed absolutely from bugs. In such work observations of fresh clean tenants would be a guide to the efficiency of the method, but even fresh tenants might introduce bugs on second-hand or borrowed furniture. The recent work of Mellanby (1939) suggests that surveys to estimate the number of bugs killed are best conducted between 4 a.m. and 6 a.m. Consequently it is probable that the proportion killed in these experiments was not as high as my results suggest; but this criticism also applies to other similar work.

The method used was simple and required very little apparatus to give good results; furthermore the thiocyanate-pyrethrum insecticide has been used with success in commercial practice. Consequently, and because the work cannot now be continued, it seems worth presenting the results as being of interest to those concerned with bed-bug disinfestation.

#### SUMMARY

1. Some simple "field" work on the disinfestation of empty, bug-ridden houses by means of liquid insecticides and a simple experiment with an occupied house are described.

2. A method of obtaining an estimate of the number of bugs killed by the application of liquid insecticides is given as well as some information about the

number of bugs found in houses. More than 2000 dead bugs were found in one small house.

3. The aliphatic thiocyanate,  $\beta$ -butoxy- $\beta'$ -thiocyanodiethylether, was tried in four different oil carriers and gave good results as a 3% solution (6% Lethane). A pyrethrum preparation in a heavy oil carrier also showed promise. A mixture of the two toxic substances was tried and found to be effective.

4. The methods of applying the insecticides are described. Good results were obtained with an ordinary hand sprayer of the horticultural type, giving a continuous spray. The premises were not sealed, but on a few occasions wood fittings were eased or removed.

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