THE CONTROL OF HOUSEHOLD INSECTS

BY WESLEY P. FLINT
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The purpose of this circular is to present what have been found to be the most effective methods for combating some of the common household insects. As a help in intelligently applying the methods of control, the points of importance in regard to the habits of these insects are included. Many of these insects occur almost exclusively in human dwellings, and probably no other class of insects causes so much personal annoyance. By taking proper measures, however, they may, as a rule, be easily and quickly controlled with but little expense.

ANTS

Ants of various kinds are among the most annoying household insects in Illinois. It is hardly possible to find a housewife who has not experienced some trouble with these little pests.

Pharaoh's Ant

Of the many kinds of ants that occur in houses, the most common and the most annoying is the very small, reddish orange species which is found in great numbers in all parts of buildings. This is known as Pharaoh's ant.\(^1\) It exhibits a marked fondness for all foods, especially for lard, bacon, and various other meats. It also feeds on sweets and on animal products used in clothing. Its nest is sometimes constructed outside the house, but more often in the walls or the foundation. Each nest contains two or three queens and the rate of reproduction is very high, so that a few months after a colony is established it may contain several hundred workers.

Control. This ant is the most difficult to control of any of the species infesting houses in this state. There are two means, however, by which control can be accomplished—trapping and poisoning.

Trapping. For trapping, sponges wet with sirup, or tin boxes having holes punched in the tops and containing sirup, should be placed about the house in spots most frequented by the ants. When these sponges or boxes have become filled with the ants, they should

\(^1\)Monomorium pharaonis
be dropped in boiling water, and then again filled with the sirup and replaced. While this procedure will not destroy the colony, if persisted in it will so reduce the number of workers that they will leave the house, or at least they will become so scarce that they will not cause great annoyance.

Poisoning. For poisoning these ants, a sirup containing a small percentage of poison should be used. If a strong poison is used, the ants will detect it and refuse to feed upon it. Ordinary sugar sirup is not particularly attractive to them. A number of sirups have been tried in which meat products and meat extracts have been used, but these do not seem to be especially attractive. The only sirup found effective against these ants is one made in the following manner:

Boil together the following materials for thirty minutes:

- Granulated sugar ..................... 4 pounds
- Water .................................. 4 pints
- Tartaric acid (crystallized) .......... 3 grams
- Benzoate of soda ...................... 3 grams

Dissolve sodium arsenite in hot water in the following proportion:

- Sodium arsenite (C.P.) ............... ¼ ounce
- Hot water ............................. 3 fluid ounces

When the above solutions have cooled, add the second to the first and stir well. Then add two-thirds of a pound of strained honey to the resulting sirup and mix thoroly.

The ingredients for this sirup may be purchased from any drug store, and should be carefully weighed by the druggist. Mix carefully according to the directions given.

While this bait is somewhat difficult to make, it is generally effective against these ants. Small pieces of sponge should be thoroly soaked in
the sirup and placed in tin boxes, the lids of which have been punched with several holes in order to give the ants ready access to the bait. A few strands of excelsior may be substituted for the sponge. Several of these boxes should be placed in pantries, closets, and other parts of the house where the ants are numerous. The bait should be renewed from time to time, and if the ants cease feeding in any one spot, the location of the tins should be changed. It will be two or three weeks after this bait is put out before the effect on the ants will be noticeable, as the amount of poison contained is not sufficient to kill at once.

In some cases these ants may be poisoned by baiting with small pieces of bacon rind into which a small amount of tartar emetic has been worked. Remember that the material is poisonous and must not be placed where children or pets will have access to it.

**Little Black Ant**

Another species of ant often found in houses is about the same size as Pharaoh's ant, but is jet black. This ant\(^1\) differs from

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\(1\) *Monomorium minitum*
Pharaoh’s ant in preferring sweets for food, and also in the fact that it does not construct its nest within the walls of houses, but in the soil outside.

**Control.** The best means of combating this ant is to find the nest, which may be done by tracing a line of workers back from where they are feeding, and destroy it by the use of carbon bisulfid. To apply this fumigant, make several holes, a little larger than a lead pencil and about six to eight inches deep, in the nest. In each of these holes pour one tablespoonful of carbon bisulfid, stop with a wad of wet earth, and cover the whole area treated with a heavy blanket or piece of canvas. In using carbon bisulfid one should remember that this gas is explosive when mixed with air, and all fire must be kept away.

The poison bait recommended for Pharaoh’s ant is also effective against this species.

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**Corn-Field Ant**

Another species of ant commonly found in houses is the brown corn-field ant.¹ The nest of this species is made outside of buildings.

![Corn-Field Ant](image)

**Control.** This ant may be poisoned with a sirup made as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>1 pound</td>
</tr>
<tr>
<td>Water</td>
<td>1 quart</td>
</tr>
<tr>
<td>Arsenate of soda</td>
<td>125 grains</td>
</tr>
<tr>
<td>Honey</td>
<td>1 tablespoonful</td>
</tr>
</tbody>
</table>

Boil the first three ingredients until the arsenate of soda is thoroughly dissolved and then add the honey.

This sirup should be used in the same way as is described for the sirup used for Pharaoh’s ant.

Nests of this ant may be destroyed by carbon bisulfid applied in the same manner as for the little black ant.

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¹*Lasius niger americanus*
Large Black Ant

A black ant, much larger than any of the species described, is also sometimes found in houses. It is not easily poisoned. The nests, which are of considerable size, are always constructed in the ground.

Control. The best method of controlling this ant is to find the nest and treat with carbon bisulfid. With this species, however, larger and deeper holes will have to be made and about two tablespoonfuls of the carbon bisulfid poured in each of the six or eight holes made in the nest. The area treated should be covered as described before with a blanket or canvas.

WHITE ANTS or TERMITES

While the white ant is generally considered a tropical or subtropical pest, there are certain species which often become very numerous and destructive in Illinois. These insects are really not true ants, differing quite markedly from them in their habits and in the organization of their colonies.

The white ant most common in this state builds its nest in the ground, usually selecting a place where there is considerable accumulation of decaying wood or other organic matter. Its food consists of wood and wood products, clothing, leather, and tissues of growing trees and plants. The greatest damage done by these ants in this state is caused by their habit of attacking the timbers and other woodwork of buildings. They almost always start in foundation timbers which come in contact with the ground. Usually they eat their way thru these timbers, leaving a mere honey-combed shell. If they are forced to travel over the surface, they construct a covered passageway, or tube, made of earth and bits of masticated wood which soon harden. They may penetrate the timbers and floors in all parts of the building and so weaken the supports that they collapse. It is absolutely necessary for the ants to have access to the ground, as they require a large supply of moisture at all times.

The colonies contain several groups of individuals, consisting of workers, soldiers, and the males and females, called kings and queens. In the spring of the year the ants "swarm" and the young kings and queens leave the colony. This swarming habit often first calls attention to the presence of the ants in houses, as at that time hundreds of the winged individuals come up thru cracks in the floors and walls, and are found crawling about the room and the windows.

Control. When a building is heavily infested with these insects, cleaning them out often means considerable expense. If possible, the main colony should be located by tracing the passageways of the ants

1Formica fusca
2Reticulitermes flavipes
FIG. 4.—WORK OF WHITE ANTS IN FOUNDATION TIMBER OF BUILDING
back from the point where they are entering the building and the colony should then be dug up and destroyed by saturating with kerosene. The passageways should also be broken up and thoroly drenched with kerosene. In order to find the point at which the ants enter the building, it is sometimes necessary to tear up the floors, exposing all the woodwork which comes in contact with the ground.

If the main colony cannot be located, all woodwork found infested should be removed. In any event, all wood coming in contact with the ground should be treated with creosote or impregnated with 1-percent solution of bichlorid of mercury. The creosote treatment is preferable. White ants remaining in the wood above the ground, whose contact with the ground is cut off by the removal of the foundation timbers, will die, as it is absolutely necessary for them to have contact with the earth to secure a supply of moisture.

In constructing buildings, it is well to treat with creosote all wood coming in contact with the ground, as a precaution against the work of these insects.1

**BEDBUG**

While the annoying, repulsive bedbug2 is many times considered a mark of poor housekeeping, this pest may, as a matter of fact, appear in the most carefully kept houses. Once having obtained lodgment in a house, these insects may persist for a number of years, one or two appearing at considerable intervals of time. This fact will be readily understood when it is known that the insect may live from six to ten months between meals, and still be in a fairly vigorous condition.

Bedbugs are mahogany-brown, with round, flattened bodies about one-eighth of an inch across when full grown. They are nocturnal in habit, hiding during the day in the cracks of beds or behind wall paper or objects hanging on walls, their flat bodies allowing them to enter very small openings. The eggs are laid in the places where the bugs find concealment. The time of incubation varies, depending on the temperature.

**Control.** The best method of eradicating these insects from houses is to fumigate with hydrocyanic acid gas. (For directions for use, see page 22.)

Where for any reason fumigation cannot be practiced, the bugs may be killed by applications of oils. These should be forced into the cracks and crevices in beds, walls, behind wall paper, baseboards, or any place in which the bugs may seek shelter during the day. Kero-

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1Further particulars with regard to combating white ants are given in a special publication which will be sent to those requesting it. Address the State Entomologist, Natural History Survey, Urbana, Illinois.

2*Cimex lectularius*
sene is somewhat better than gasoline for this purpose, and is the most effective of any oils that can be readily obtained.

Mercuric chlorid, or corrosive sublimate, as it is commonly called, is entirely effective against these insects in any stage, when used either in water at a 6-percent solution or in the powdered form as a dust.

**CARPET BEETLES or BUFFALO BUGS**

Two species of carpet beetles, or "buffalo bugs," occur throughout this state. These insects feed in much the same manner as clothes moths but on a much greater variety of substances. They are particularly injurious to woolen carpets that are tacked down on floors and allowed to remain undisturbed for some time. The injury is done by the larvae. In this stage they are dark brown, blunt at one end and tapering at the other, and are covered with bunches of stiff, brown hairs, which give them a somewhat woolly appearance. On becoming full grown the larva transforms to a pupa, but differs very
little in appearance. After remaining in this stage for a short time, the skin of the pupa splits and the full-grown beetle emerges.

In the beetle stage one species is a brown or brownish black with irregular, gray markings on the wing covers, two patches of gray on the body just below the head, and a line of brick red down the middle of the back. The beetles are about one-eighth of an inch long and are fairly strong flyers, traveling on the wing from house to house. In addition to feeding on carpets, this species feeds on all kinds of woolen goods and on any dried product containing a high percentage of protein. In museums it is particularly destructive to mounted or pinned specimens.

The other species of carpet beetles which occurs commonly in this state varies somewhat from the one just described in that the beetle is black without markings and is about one-sixth of an inch long. Its food habits are much the same as those of the species just described, altho somewhat more varied, it having been known to cause damage to flour, cereal products, feathers, and many other substances. Both of these beetles breed throughout the winter in heated houses.

**Control.** Both species of carpet beetles described may be successfully controlled by fumigation with hydrocyanic acid gas or carbon bisulfid tho the latter will not always destroy the eggs. (For directions for use, see page 22.)

Naphthalene flakes scattered liberally under the carpets, rugs, or about rooms where the beetles are abundant will kill large numbers of them and tend to prevent infestation.

$^1$Anthrenus scrophulariae

$^2$Attagenus piceus
Chiggers, as they are called, are various species of mites in the young stage. They are often called harvest mites. These creatures, which are really not insects, are beneficial in that they infest various large insects and also feed on insect eggs.

The mites live over the winter in shelters in the ground. In the spring they are quite conspicuous because of their bright red color, and are often observed crawling over the damp ground, where they lay their eggs in crevices. The young mites, on hatching, feed on various insects and their eggs.

During the summer months the mites crawl up on the tips of grass blades or on the leaves of various plants, and from there, when the opportunity offers, they fasten themselves to the bodies of insects and animals. Unfortunately, they also readily attach themselves to the clothing of anyone walking thru the grass or bushes. They crawl about over the skin, but are so small that they usually escape detection. Frequently, however, they start to burrow into the skin, along a hair follicle. This is suicidal to the chigger, as he soon dies after becoming embedded in the flesh. The presence of the body of the chigger in the skin sets up an intense irritation, accompanied by more or less swelling on some persons. The irritation is generally worse with thin-skinned people and those of light complexion.

Control. Lawns which have become overrun with chiggers may be easily cleaned out. This may be done by wetting a piece of canvas or a gunny sack with kerosene, wringing it out so that the oil will not drip from it, and dragging it over the entire surface of the lawn. The oil will kill all the young chiggers on the ends of the grass blades. The canvas must not be allowed to remain in one place for any length of time, as the kerosene will kill the grass. After the entire lawn has been gone over, it is well to sow it liberally with flowers of sulfur. Often flowers of sulfur used alone will rid the lawn of the chiggers.

If one is compelled to go about places that are infested with chiggers, partial freedom from their attacks may be gained by sifting finely powdered sulfur thru the clothing, especially in the socks and shoes.
CLOTHES MOTHS

Three species of clothes moths\(^1\) occur commonly in this state. While they differ somewhat in the character of their work and in their life histories, these points of variation are not so great as to make a difference in the means of control.

In the adult stage the moths are about one-fourth of an inch long, the wings gray or brown, or slightly mottled with darker patches. These moths lay their eggs in clothing or woolen materials of various sorts, as well as upon furs and skins. All the damage is caused by the small worms which hatch from these eggs. When full grown the worms are a little more than one-fourth of an inch long. They then inclose themselves in silken cocoons, either upon the fabric where they have been feeding or in the corners of rooms, about the ceilings, and in like places. Here they change to a brown, resting stage, and later emerge as adult moths.

**Control.** All clothes should be thoroly aired and, if possible, exposed to bright sunlight before being put away. Complete protection from these insects may be obtained by scattering liberal quantities of flake naphthalene in all clothing when it is put away. The only objectionable feature is the odor of the naphthalene, but a thorough airing in bright sunlight will soon dispel this.

Fumigation with hydrocyanic acid gas will kill these insects in all stages, but the clothing should be piled or hung loosely to insure its being penetrated by the gas.

Carbon bisulfid is also effective against these insects in all but the egg stage. To insure a complete destruction of the moths a second fumigation should be made after two or three weeks. (See page 22.)

FLEAS

Any building to which animals have access is likely to become infested with fleas. There are a number of species which occur in this country, the cat flea\(^2\) and the dog flea\(^3\) being by far the more common in Illinois.

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\(^1\) *Tinea pellionella; Tineola bisselliella; Trichophaga tapetzella*

\(^2\) *Ctenocephalus felis*

\(^3\) *Ctenocephalus canis*
Nearly every one is familiar with the adult flea, but in order to successfully combat this little pest, it should be borne in mind that the adult is only one of the four stages thru which this insect passes. The full-grown fleas confine themselves mainly to the animals on which they feed, altho they frequently leave their host and drop to the ground or floor. They deposit their eggs on the hairs of the animals which they infest, also in cracks in floors, in dust, or in any place frequented by animals, such as the beds of dogs and cats or the basements of buildings. These eggs hatch into small, grayish white worms, no larger than a thread. The worms feed on animal or vegetable refuse, but do not feed directly on the blood of any animal. They become full grown in from two to four weeks after hatching, and at that time spin their cocoons. While in the cocoons they change to a resting stage in which they do not move about or feed. In from seven to twelve days they emerge as full-grown fleas. They may live from fifty to one hundred days without food. When they are able to feed at frequent intervals and other conditions are favorable, they will live from one hundred to five hundred days, the length of time varying with the species. Having a knowledge of the life history of these insects, it is easy to understand how basements or rooms where animals have been sleeping will sometimes be found teeming with them, even tho no animals have been in the rooms for several weeks.

**Control.** Fleas may be controlled in several ways. Outbuildings or sheds having dirt floors may be rid of the pests by covering the ground with a coating of salt about one-eighth of an inch deep and allowing it to stand for a week or more.

Infested houses or house basements may be best rid of these insects by fumigating with hydrocyanic acid gas. (See page 22.)

In houses or basements which cannot be made tight, the fleas may be killed by spreading a layer of flake naphthalene over the floors, care being taken that the entire surface is covered. This should be allowed to remain for at least a week. The crude naphtha-
lune is just as effective as the refined for this purpose and is cheaper. It is always well to wash the floors thoroughly with a strong soapsuds immediately after any of these treatments.

Animals themselves may be rid of fleas by being dipped in or washed with a strong creolin solution or tobacco dip. A number of good dips may be purchased from the larger seed stores, drug stores, or implement dealers. They should be used according to directions given by the manufacturers.

**GRAIN BEETLES and MOTHS**

Sometimes when opening a package of cereal, or examining a bag of rice or other grain products used for food, one will find numerous small, reddish beetles crawling over the contents and inside of the package. Closer examination will show very small, brownish white grubs, or worms, as they may be termed, feeding upon the cereal. Upon examining the package one will notice an accumulation of fine sawdust-like particles in the bottom, caused by the feeding of these insects. This insect is known as the confused flour beetle, one of the household pests most frequently encountered in all kinds of grain products, as well as in prepared foods such as crackers and cookies. When the beetles are exposed to the light they run about very rapidly, seeking some hiding place. Not only are they a pest of houses, but they also occur in granaries, drug stores, seed houses, grocery stores, and mills, feeding upon a great variety of products.

A beetle somewhat similar to the confused flour beetle but a little browner is often found in the same places and feeds in about the same manner. It is easily distinguished by its six prominent teeth on either side of the thorax, giving it the name of the saw-toothed, or rough-necked, grain beetle.

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1. *Tribolium confusum*
2. *Oryzaephilus surinamensis*
CONTROL OF HOUSEHOLD INSECTS

FIG. 11.—Saw-Toothed Grain Beetle. Adult, Pupa, and Larva (U.S.D.A.)

FIG. 12.—Indian Meal Moth, Plodia interpunctella. a, Adult; b, Dorsal View of Larva; c, Side View of Larva; d, Ventral View of Pupa. Enlarged as indicated.
In like places one will often find small moths, some of them resembling clothes moths, others larger and more conspicuously marked. There are three or four different species, the more common\(^1\) being pale brown with darker markings on the wings. In some species\(^2\) a part of the wing is much darker in color. The young of these moths, which are white or greenish yellow worms with brown heads, feed upon all kinds of grains, cereals, and in fact upon a large variety of food products.

These insects often become abundant in pantries or other places where groceries are stored, and even tho all food products are removed a few of the insects may find sufficient food to nourish them in the cracks of floors, behind baseboards, or in the corners of shelves. Wherever they occur in buildings or storehouses, prompt measures should be taken to eradicate them, as they will often cause a considerable loss, to say nothing of the inconvenience of finding numbers of them in foods.

**Control.** The measures for controlling these insects consist of fumigation with either hydrocyanic acid gas or carbon bisulfid, and the use of heat. (For directions, see pages 22 and 23.)

**HOUSE CENTIPEDE**

On turning on the lights in basements one will sometimes see several grayish or grayish brown creatures, with many long legs, scuttling rapidly over the walls, floors, or ceilings. Occasionally these house centipedes,\(^3\) or “hundred-legged worms,” as they are sometimes called, will also be encountered in other parts of the house. They move so rapidly that it is very difficult to get a correct idea of their appearance. They frequent damp places, often sheltering under rags or other trash where some moisture is collected. When full grown they are two or three inches in length, and with

\(^1\) *Sitotroga cerealella*  
\(^2\) *Plodia interpunctella; Pyralis farinalis*  
\(^3\) *Scutigera forceps*
their numerous long legs present a somewhat alarming appearance, further emphasized by their habit of sometimes darting toward one when they are first disturbed. They are really beneficial, as they do not feed at all on fabrics or substances that are used for food. So far as has been determined, they eat only insects, and have been found to feed upon such pests as roaches, clothes moths, and bedbugs.

Control. Should these centipedes become numerous enough to prove really annoying, they may be killed by fumigating as for bedbugs and roaches. The liberal use of pyrethrum powder about water pipes and other damp places where the centipedes are in the habit of resting will prove effective in reducing their numbers. This powder is only mildly poisonous to human beings. It loses its strength on being exposed to the air for several weeks.

HOUSE FLY

Since something of the habits of the house fly have become known, the very mention of it brings up unpleasant thoughts of filth and disease. This insect, which is found associated with man throughout the world, is one of the more common factors in the spread of many diseases. The information which has been gained from the study of this insect during the past fifteen years has made possible the development of control measures which will greatly reduce its numbers in any community.

The house fly breeds in all kinds of filth where there is a sufficient degree of warmth and moisture. Studies made both in town and in country in various parts of the United States have shown that by far the greatest number of flies originate in horse manure. They also breed in other kinds of excreta, and develop in large numbers in city dumps where there are accumulations of decaying vegetable matter. Eggs are deposited by the adult flies on the material in which they breed, and these usually hatch within twenty-four hours. The small white maggots become full grown, under the most favorable conditions, in four or five days, tho this period may be prolonged by low temperatures. The maggots then work their way thru the ground for some distance from the manure and there change to brown puparia. They remain in this stage for four or five days and emerge as full-grown flies. The fly works its way up thru the soil, and after a very few days the female begins depositing eggs. Each female lays, on an average, over a hundred eggs. There are five to eight generations during a season. The flies pass the winter in the adult stage, hidden away in buildings,

\textsuperscript{1}Musca domestica
basements, and other places that offer them sufficient protection from the cold.

**Control.** Fly prevention may be grouped under four heads: cleanliness, trapping, poisoning, and screening.

**Cleanliness.** The most important point in control is the cleaning up of breeding places. All manure from stables in cities or towns should be deposited in tight boxes, cans, or rooms, and at least once every week should be removed and spread over the ground. If the manure is hauled away from town in freight cars, they should by no means be allowed to stand more than a week before being moved. In the country, during the warm months manure should be spread on the fields at least once a week. Flies will not breed in manure spread over the ground and exposed to the rays of the sun.

The best method so far found for preventing flies from congegating in stables and breeding in the manure which will accumulate there is to clean out the stables once every twenty-four hours, and after each cleaning to sprinkle a small amount of chlorid of lime over the floors behind the horses. Care should be taken not to sprinkle the chlorid of lime up in the stalls where it would come in contact with the horses when they lie down, as this would be likely to cause some burning of the skin. It is not necessary to use a large quantity of the chlorid of lime, one pound per day being sufficient for ten or twelve horses.

Garbage deposited on city dumps should be covered with earth at least once every twenty-four hours. A much better plan for disposing of garbage is to burn it in an incinerator.

**Trapping.** The numbers of flies around houses or stores may be greatly reduced by the use of traps. Several good types of traps are on the market. The balloon and cone-shaped types are the more common and effective. These traps may be baited with bits of meat scrap, bread and milk, molasses, or vinegar and sugar. Records show a catch of as high as twelve thousand flies in a day.

**Poisoning.** Numerous prepared poisons are on the market, which are to be moistened and exposed to the flies. Many of these poisons are effective and will kill, within a few minutes, all flies feeding upon them.

One of the best poisons which can be prepared at home is made by mixing thoroly —

- **40-percent formalin** .................. 2 tablespoonfuls
- Sweet milk or buttermilk .................. \( \frac{1}{2} \) pint
- Water .................................. \( \frac{1}{2} \) pint

This should be exposed in shallow dishes. A piece of bread placed in the middle of the dish will add to its attractiveness to the flies.

When flies have become excessively numerous in rooms, they may be stupefied so that they will drop to the floor, by burning pyrethrum
powder on a hot stove lid or any hot sheet of metal. They may then be swept up and burned. Flies may also be killed by dusting them with the fresh pyrethrum powder.

Screening. All foods, including fruits and vegetables, that are exposed for sale should be carefully screened to prevent contamination by flies. Stores that do not observe this practice should not be patronized, as there is danger in eating food over which flies have been crawling. It is hard to understand why anyone would buy food that is exposed to flies, when he must know that the flies have probably just come from the filthiest place in the neighborhood, and that their bodies and feet are covered with all kinds of filth and the germs of various diseases, which they leave behind them wherever they crawl.

ROACHES

Roaches are among the most annoying, and to many the most repulsive, of the insects commonly found infesting houses. Several kinds of roaches occur in this state. Of the two more annoying species, one\(^1\) is quite large and a dark chestnut brown, the other\(^2\) is medium-sized, rather long-winged, and very light brown. The latter species is by far the more destructive. It is often called the German roach, or Croton bug.

Roaches reproduce by means of eggs. These are formed in a brown case or capsule which is carried for some time partly protruding from the tip of the abdomen. These capsules of twenty-five or more eggs are generally dropped behind some shelter. Except in size and in the lack of wings, the young, on hatching, differ but little from the adults. This insect does not pass thru any pupal, or resting, stage, but gradually increases in size, changing its skin several times before reaching maturity. There are one or two generations a year, depending on the species.

Control. All species of roaches may be controlled by practically the same methods. The most effective and cheapest method is to scatter liberal quantities of sodium fluorid over the parts of the house frequented by them, especially in the dark corners of closets or pantries, under sinks, around drain pipes, and behind baseboards or in cracks where they may enter rooms. If this treatment is continued for several weeks, the premises will be rid of these troublesome pests. In using this powder, remember that a liberal amount of it must be applied, so that it will show a white coating over the surface. In dusting behind baseboards or in any cracks, it is well

\(^{1}\text{Periplaneta americana}\)
\(^{2}\text{Blatella germanica}\)
to use a small powder gun for driving in the powder. As sodium fluorid is poisonous, care should be taken that it does not come in contact with foods.

Houses once cleared of roaches will not long remain free if other houses in the immediate neighborhood are infested, as roaches are very active insects and move from house to house. There are records of well-defined migrations in which large numbers of roaches have left one house and moved to another nearby.

**SILVERFISH**

When going over the contents of a closet or trunk containing books or pamphlets which have not been disturbed for some time, one will often see small white or grayish brown, glistening insects
scurrying rapidly about, hurrying to hide themselves from exposure to light. These insects are known as silverfish, or fire brats. They sometimes become very numerous in houses and cause considerable damage by eating the paste and glue from the bindings of books and pamphlets, or feeding upon the paste on the back of wall paper.

In libraries, books that are not disturbed for some time may be almost destroyed. Silverfish are also often found around pantries where foods are stored, and have been known to feed upon a large variety of food substances as well as on furs, leather, and the like.

Control. This insect may be controlled by using poisoned baits spread upon bits of paper or cardboard and placed in their haunts. One of the most effective baits is made by mixing the following:

- Very thin glue ......................... 1 pint
- Powdered arsenate of lead
- or
- Paris green ............................. 1 teaspoonful

In experimental work carried on in some of the adjoining states glue has been found superior to sweetened flour paste, altho the latter is sometimes effective. It seems evident that this insect has a preference for foods containing animal matter, altho it often feeds on starches and other purely vegetable products.

Fumigation with hydrocyanic acid gas may be used against this insect, but the damage caused by the insect is not generally serious enough to warrant this expense. (For method of fumigation see page 22.)

This insect can also be controlled to some extent by thoroughly dusting with fresh pyrethrum powder the places which it frequents. It should be noted that if this powder has been exposed to the air for some time it will lose most of its effectiveness.

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1. *Leptisma saccharina*
METHODS OF FUMIGATION

FUMIGATION WITH HYDROCYANIC ACID GAS

Hydrocyanic acid gas is generated by combining water, commercial sulfuric acid, and sodium cyanide. It is non-explosive but is extremely poisonous to plant and animal life, and hence due precaution must be used in handling it. Being lighter than air, it has but little penetration downward. Best results will be obtained when the temperature is between 60° and 90° F. The gas should not be used at a temperature below 50° F.

First see that all rooms to be fumigated are made as nearly airtight as possible. All cracks around windows or doors should be chinked with rags or paper. All plants and all foods containing a high percentage of water, such as cooked cereals and fruits not in sealed jars, should be removed before fumigating with this gas. It does not discolor the most delicate fabrics or wall paper.

Ascertain the number of cubic feet contained in the rooms to be fumigated. For each one hundred cubic feet of space use—

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Sodium cyanide</td>
<td>1 ounce</td>
</tr>
<tr>
<td>Commercial sulfuric acid</td>
<td>2 fluid ounces</td>
</tr>
<tr>
<td>Water</td>
<td>4 fluid ounces</td>
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Place the water in a deep earthen or stoneware (never metal) container, and add the acid slowly. Never allow the liquid to come to within less than ten inches of the top of the vessel. When using over two pounds of cyanide it is better to provide more than one container. Having everything ready, drop the cyanide, which has been loosely wrapped in paper, into the container farthest from the exit. Instantly drop cyanide into the remaining containers and leave the room as quickly as possible. Close the room and keep it closed for at least one hour, better twenty-four. Open from the outside and allow it to air thoroughly before entering. Bury the residue remaining in the container.

Always keep in mind the extremely poisonous nature of this gas. One full breath would render a man unconscious and probably prove fatal.

FUMIGATION WITH CARBON BISULFID

Commercial carbon bisulfid is a nearly colorless, ill-smelling liquid that changes to gas very rapidly when exposed to the air at ordinary temperatures. This gas when mixed with air is very explosive. It is much heavier than air and sinks to the bottom of any container in which it is used. The gas is deadly to all forms of insect life if used in sufficient strength and at temperatures at which the insects are active. If the temperature is below 60° F., many of the insects will not be killed.
In using this gas it is necessary to have a container or room with sides and floor as nearly air-tight as possible. If only a few articles are to be fumigated, a tight barrel or trunk makes a very convenient container. Place the articles to be fumigated in the container, distributing them so as to allow air space between them. If clothing is to be fumigated, pile loosely rather than roll or fold. The carbon bisulfid may be best applied by pouring it on several pieces of old cloth which have been laid on top of the articles to be fumigated. While the liquid does not discolor fabrics, it should not be poured directly on them, as it leaves a slight residue. Apply at the rate of one pound of carbon bisulfid to one hundred cubic feet of space. The container should then be covered as tightly as possible, or in the case of a room, it should be tightly closed for at least three hours, better for twenty-four.

As carbon bisulfid does not always kill the eggs of insects, it is advisable to repeat the fumigation in two or three weeks.

**FUMIGATION WITH SULFUR**

Fumes of burning sulfur, from sulfur used at the rate of one pound to 1,000 cubic feet of space are fairly effective for killing insects, although a much higher dosage than this will have to be used in order to kill the eggs of most insects. Sulfur candles, which may be had in various sizes, are a convenient form of sulfur for fumigating. Sulfur has the disadvantage of discoloring fabrics and wall papers, and is not nearly so effective a fumigant as hydrocyanic acid gas or carbon bisulfid.

**APPLICATION OF HEAT**

Insects in all stages are killed if exposed for three hours to a temperature of 125°F to 135°F. Packages of cereals and dried fruits, or clothing, may be heated to the above temperature in an oven. It is often possible in the summer, by the use of a furnace or an oil or gas heater, to raise the temperature of a room to the degrees above mentioned. This makes a very convenient way of treating infested clothing, cereals, or other food products.

In using this method, it must be remembered that it will take some time for the centers of packages of foods or piles of clothing to become heated, and hence all materials treated in this manner should be exposed to the high temperatures for a sufficient length of time to allow the heat to penetrate.

**NOTE.**—Formaldehyde fumes or solution are effective as a germicide, but are useless for killing insects.
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