

THE NUISANCE OF ROACHES in offices and in living rooms of houses can be reduced, if not removed entirely, by the elimination of all attractive substances.

Roaches will not frequent rooms unless they find some available food material. If food can be kept from living rooms and offices, or care exercised to see that no such material is placed in drawers where fragments or an attractive odor will be left, the roach nuisance can be largely restricted to places where food necessarily must be kept. In such places the storage of food material in insect-proof containers or in ice boxes, together with thoroughgoing cleanliness, will go a long way toward preventing serious annoyance.

Roaches as household pests may be controlled by the use of various poisons, repellents, and fumigants, and by trapping. These methods of control are explained fully on pages 11-14. Of the powders, the most efficient is sodium fluoride, a liberal dusting of which about the infested premises furnishes an effective means for the elimination of these pests.

Cockroaches are the commonest and most offensive of the house pests. Four kinds are often found in houses, offices, etc. These are the American roach, a native insect; the European or oriental roach, known in England as the black beetle; the Australian roach; and the little German roach, commonly known in this country as the Croton bug. These species are illustrated and described in this bulletin, and information is given on the distribution, history, habits, and transformation of the roach family in general.

COCKROACHES.

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WHERE FOUND.

ROACHES are among the commonest and most offensive of the insects which frequent human habitations. They belong to a very extensive family, the Blattidae, comparatively few of which, fortunately, have become domesticated. In temperate countries some four or five species are very common household pests, and a few occur wild in the woods; but they are essentially inhabitants of warm countries, and in the Tropics the house species are very numerous, and the wild species occur in great number and variety, many of them being striking in shape, coloration, and size, the wing spread of one species being more than 6 inches. Under suitable conditions

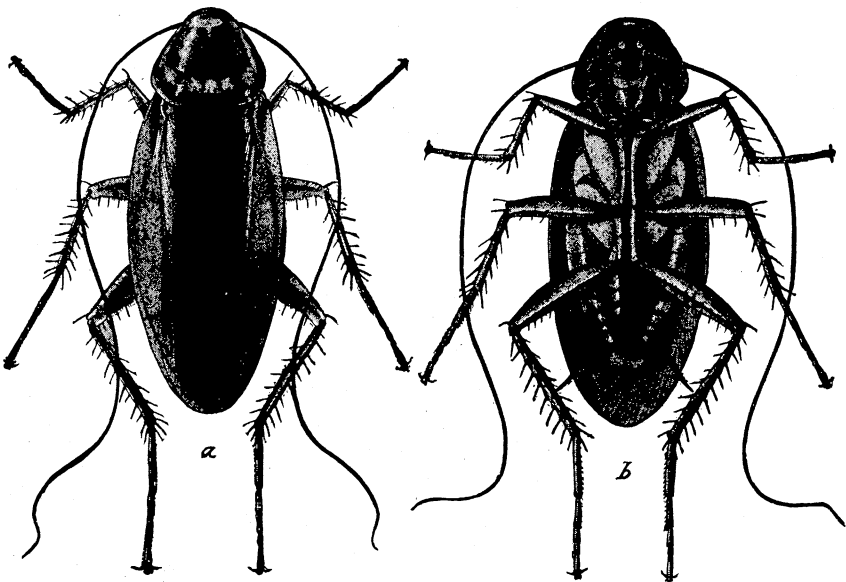


FIG. 1.—The American roach: *a*, View from above; *b*, from beneath. Enlarged one-third.

in the more northern latitudes the domestic species often multiply prodigiously, and even in the far north a species occurs in the huts of the Laplanders, and sometimes entirely devours the stores of dried fish put away for winter consumption.

The great majority of the roaches live outdoors, and in warm countries have the reputation of living on plants and sometimes being very injurious. That roaches will eat fruits and the starchy tubers and other products of plants is a common observation, but that they ever subsist on the green foliage of plants may be open to doubt.

The house roaches of to-day were undoubtedly very early associated with man in his primitive dwellings, and through the agency of commerce have been carried to all quarters of the globe. On shipboard they are always especially numerous and troublesome, the moisture and heat of the vessels being particularly favorable to their development. It is supposed that the common oriental cockroach, or so-called "black beetle" of Europe,¹ is of Asiatic origin, and it is thought to have been introduced into Europe in the last two or three hundred years. The original home of this and another common European roach, the German roach,² however, is obscure, and they have probably both been associated with man from the earliest times, and naturally would come into the newly settled portions of Europe from the older civilizations of Asia and Egypt.

Of the other two domestic roaches especially considered in this bulletin, the Australian roach,³ as its name implies, is a native of Australia, and the American roach,⁴ of subtropical and tropical America.

Rarely do two of the domestic species occur in any numbers together in the same house. Often also of two neighboring districts one may be infested with one kind, while in the other a distinct kind is the commoner one. The different species are thus seemingly somewhat antagonistic, and it is even supposed that they may prey upon one another, the less numerous kinds being often driven out.

APPEARANCE.

The house roaches are rather uniformly dark brown or dark colored, corresponding with their habit of concealment during daylight. They are smooth and slippery, and in shape broad and flattened. The head is bent under the body, so that the mouth parts are directed backward and the eyes directed downward, conforming with their groveling habits. The antennæ are very long and slender, often having upward of 100 joints. The males usually have two pairs of wings, the outer ones somewhat leathery and the inner ones

¹ *Blatta orientalis* Linnaeus.

² *Blattella germanica* Linnaeus.

³ *Periplaneta australasiae* Fabricius.

⁴ *Periplaneta americana* Linnaeus.

more tissuelike and folded once lengthwise. In some kinds, as, for instance, the "black beetle," the females are nearly wingless. The legs are long and powerful and armed with numerous strong bristles or spines. The mouth parts are well developed and have strong biting jaws, enabling these insects to eat all sorts of substances.

HABITS.

In houses roaches are particularly abundant in pantries and kitchens, especially in the neighborhood of fireplaces, on account of the heat. For the same reason they are often abundant in the oven rooms of bakeries or wherever the temperature is maintained above the normal. They conceal themselves during the day behind baseboards or furniture, or wherever security and partial protection from the light are afforded. Their very flat, thin bodies enable them to squeeze themselves into small cracks or spaces where their presence would not be suspected and where they are out of the reach of enemies. Unless routed out by the moving of furniture or disturbed in their hiding places, they are rarely seen, and if discovered make off with wonderful celerity, with a scurrying, nervous gait, and usually are able to elude all efforts at their capture or destruction. It may often happen that their presence, at least in the abundance in which they occur, is hardly realized by the housekeeper unless they are surprised in their midnight feasts. Coming into a kitchen or pantry suddenly, a sound of the rustling of numerous objects will come to the ear, and if a light be introduced often the floor or shelves will be seen covered with roaches hastening to places of concealment. In districts where the large American roach occurs they sometimes swarm in this way at night in such numbers that upon entering a small room in which they are congregated one will be repeatedly struck and scratched on the face and hands by the insects in their frantic flight to gain concealment.

The black roach is less active and wary than the others, particularly the German roach, which is especially agile and shy.

The domestic roaches feed on almost any dead animal matter, cereal products, and food materials of all sorts. They are also said to eat their own cast skins and egg cases, and it is supposed that they will attack other kinds of roaches, or are, perhaps, occasionally cannibalistic. They will also eat or gnaw woolens, leather (as of shoes or furniture), and frequently are the cause of extensive damage to the cloth and leather bindings of books in libraries and publishing houses. The sizing or paste used on the cloth covers and in the binding of books is very attractive to them. The surface of the covers of cloth-bound books is often much scraped and disfigured, particularly by the German cockroach,¹ and the gold lettering is sometimes eaten

off to get at the albumen paste. On shipboard the damage is often very extensive on account of the vast numbers of cockroaches which frequently occur there, and there are reliable accounts of entire supplies of ship biscuits having been eaten or ruined by roaches.

The damage they do is not only in the products actually consumed, but in the soiling of everything with which they come in contact. They leave, wherever they occur in any numbers, an offensive, sickening odor, well known as the "roachy" odor, which is persistent and can not be removed from shelves and dishes without washing with soap and boiling water. Food supplies so tainted are beyond redemption. This odor comes partly from the excrement, but chiefly from a dark-colored fluid from the mouth of the insect, with which it stains its runways, and also in part, doubtless, from the scent glands, which occur on the bodies of both sexes between certain segments of the abdomen, and which send out an oily liquid possessing a very disagreeable odor. It frequently happens that shelves on which dishes are placed become contaminated with this roachy odor, and this is imparted to and retained by dishes to such an extent that everything served in them, particularly liquids, as coffee or tea, will be noticed to have a peculiar, disgusting, foreign taste and odor, the source of which may be a puzzle, and which will naturally be supposed to come from the food rather than from the dish.

The roaches are normally scavengers in habit and may at times be of actual service in this direction by eating up and removing any dead animal material.

One other redeeming trait has been recorded of them, namely, that they will prey upon that other grievous pest of houses, the bedbug.

The cockroach, however, is far too great a nuisance itself to warrant its recommendation as a means of eradicating even the much more disagreeable insect referred to.

Roaches undoubtedly are often spread from house to house by being introduced with supplies, furniture, goods, etc. That the Croton bug, or German roach, and probably the other sorts also, may develop a migratory instinct has been witnessed by Dr. Howard and the writer in Washington. This very interesting instance of what seems to have been a true migration, in which an army of thousands of roaches by one common impulse abandoned their old quarters and started on a search for a more favorable location, illustrates, as pointed out by Dr. Howard, what is probably of frequent occurrence under the cover of darkness, and accounts for the way in which new houses frequently become suddenly overrun with these pests.

TRANSFORMATION.

The roach in the different stages of its development from egg to adult shows comparatively little variation in appearance or habits. The young are very much like the adults, except in size and in lacking wings. The eggs, instead of being laid separately, as with most other insects, are brought together within the abdomen of the mother into a hard, horny pod or capsule which often nearly fills the body of the parent. This capsule (fig. 2) contains a considerable number of eggs, arranged in two rows, the position of the eggs being indicated on the outside of the capsule by impressions. When filled with eggs the capsule often partly projects from the female abdomen and is held in this position sometimes for weeks, or until the young are ready to emerge. The capsule is oval, somewhat bean shaped, and one of its edges is usually toothed. In some instances the young are assisted to escape by the parent, who with her feet aids in splitting the capsule on the toothed edge to facilitate their exit. On hatching, it is said the young are often kept together by the parent and brooded over and cared for; at least a colony of young usually will be found associated with one or two older individuals. These insects are more or less gregarious, notably so in the case of the "black beetle" of Europe and to a less extent with the German and American roaches.

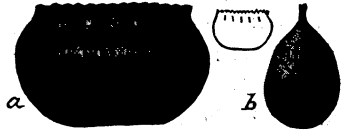


FIG. 2.—Egg capsules of the American roach; a, Side; b, end view. Natural size indicated by outline figure.

They pass through a variable number of molts, sometimes as many as seven, the skin splitting along the back and the insects coming out white and soft, but rapidly hardening and assuming the normal color. Four or five years have been said to be necessary for an individual to reach full growth; but more recent rearing experiments have not altogether confirmed these statements. Their development, however, is unquestionably slow, and probably under the most favorable conditions rarely is more than one generation per year produced. In colder countries the breeding and growth are practically restricted to the warm season. During the winter months they go into concealment and partial hibernation. The German roach has been shown to reach full growth in a variable period of from four and a half to six months. The common American roach has been reared from the egg to the adult state in the insectary. Young hatching July 11 from an egg case received from Eagle Pass, Tex., reached the adult stage between March 14 and June 12 of the following year, indicating a period of nearly 12 months for complete

development. The rate of growth of the roach undoubtedly depends very largely on food and temperature, and under unfavorable conditions the time required for development undoubtedly may be vastly lengthened. The abundance of roaches, therefore, apparently is not accounted for so much by their rapidity of multiplication as by their unusual ability to preserve themselves from ordinary means of destruction and by the scarcity of natural enemies.

THE COMMON DOMESTIC ROACHES.

The four roaches which are illustrated represent the kinds which occur most commonly in houses, bakeries, or on shipboard. The numerous tropical house kinds, many of which are perhaps only partially domesticated, and the subarctic roach of high altitudes and of the extreme north have been omitted.

The American roach (fig. 1) is the native species of this continent, originating, it is supposed, in tropical or subtropical America, and early came to the notice of our forefathers. Its domesticity doubtless resulted from ages of association with the original inhabitants. It has now become thoroughly cosmopolitan and is unquestionably the most injurious and annoying of the roaches occurring on vessels. It is sometimes numerous also in greenhouses, causing considerable injury to tender plants. It is a notorious house pest and occasionally vies with the German roach in its injuries to book bindings. One of the most serious cases of injury of this sort was reported by the Treasury Department. The backs of both cloth and leather bound books were sometimes entirely eaten off to get at the starchy paste used in the binding. This roach is very abundant in the Middle and Western States, where until recently it has been practically the only troublesome house roach. In the East it is not often so common as one or another of the following kinds, especially the German roach. In foreign countries it has not become widespread and is largely confined to seaport towns. In size it is larger than any of the other domestic kinds; it is light brown in color, and the wings are usually long, powerful, and well developed in both sexes.

The Australian roach (fig. 3) resembles very closely the American roach, but differs strikingly in the brighter and more definitely limited yellow band on the part of the back between the head and wings and in the yellow dash on the sides of the upper wings. In the United States it is the most abundant and troublesome kind in Florida and some of the other Southern States. It is already found in practically all countries.

The oriental cockroach, or "black beetle," is the common European and particularly the English kind, and is notable for the fact that the female is nearly wingless in the adult state. The wings of the male also are shortened, not reaching to the end of the body. In color it is very dark brown, almost black, shining, and rather robust, much stouter than the other kinds, making its English name of "black beetle" quite appropriate. This roach is notably gregarious in habit, that is, the individuals live together in colonies in the most amicable way, the small ones being allowed by the larger ones to sit

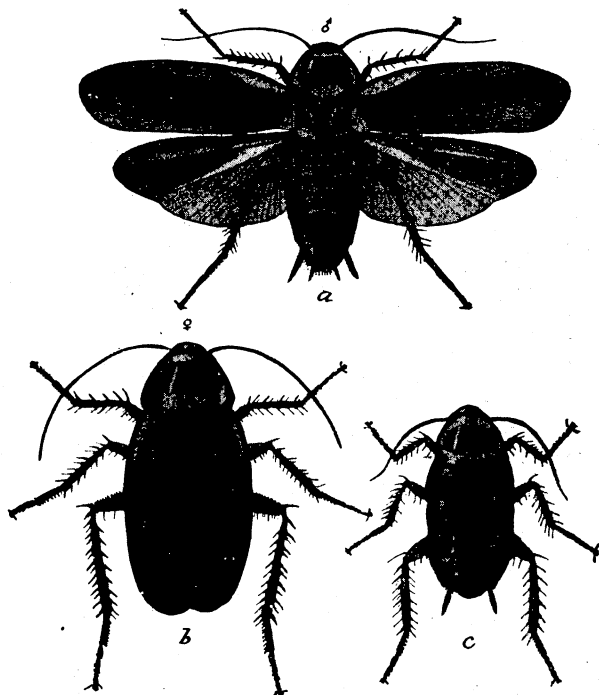


FIG. 3.—The Australian roach: a, Male with spread wings; b, female; c, pupa. All life size.

on them, run over them, and nestle beneath them without any resentment being shown. The oriental roach was a common and troublesome pest in the British colonies early in the eighteenth century, although unknown at the same time in the French Canadian possessions.⁵ It then seemed to be commonly known as the mill beetle. The early Dutch called them *kakerlach*, and in the Swedish settlements they were known as *brodätare* (bread eaters). The oriental roach is now very common in houses in the East, but is very generally

⁵ Kalm, Peter. *Travels into North America*, ed. 2, v. 1, p. 321-323; v. 2, p. 256. London, 1772.

distributed, and is the common kind even so far removed from the Atlantic seaboard as New Mexico. The characteristics of this insect are shown in the accompanying illustration (fig. 4).

The German cockroach is particularly abundant in Germany and neighboring European countries, but, like most of the other domestic kinds, has become world-wide in distribution. In this country it is very often styled the Croton bug, this designation coming from the fact that attention was first permanently drawn to it at the time of the completion of the Croton system of waterworks in New York City. It had probably been introduced long before, but the extension of the waterworks system and of piping afforded it means of

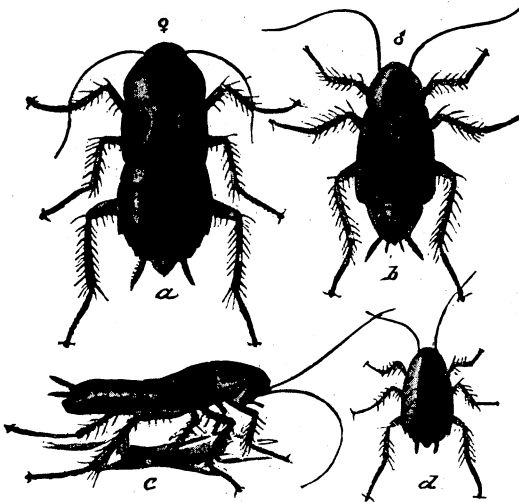


FIG. 4.—The oriental roach: a, Female; b, male; c, side view of female; d, half-grown specimen. All natural size.

entrance into residences and greatly encouraged its spread and facilitated its multiplication. The dampness of water pipes is favorable to it, and it may be carried by the pressure of the water long distances through the pipes without injury. This roach has so multiplied in the eastern United States that it has now become the commonest and best known of the domestic species, and its injuries to food products, books, etc., and the disgusting results of

its presence in pantries, storehouses, and bakeries make it really a greater pest than any of the other kinds.

It is very light brown in color, and marked on the back between the head and wings with two dark-brown stripes. It is more active and wary than the larger kinds and much more difficult to eradicate. It is the smallest of the domestic roaches, rarely exceeding five-eighths of an inch in length, and multiples much more rapidly than the others, the breeding period being shorter and the number of eggs in the capsules greater than with the larger roaches. The injury which it does to cloth-bound reports has been the source of very considerable annoyance at the Department of Agriculture and in the large libraries of eastern towns and colleges. The characteristics of the different stages, from the egg to the adult, are shown in the illustration (fig. 5).

NATURAL ENEMIES AND PARASITES.

In Europe a parasitic four-winged fly⁶ often lays its eggs in the egg capsules of the cockroach. This fly has become widely distributed over the world, following the roach. Unfortunately, its usefulness as a means of keeping the roach in check by destroying the egg

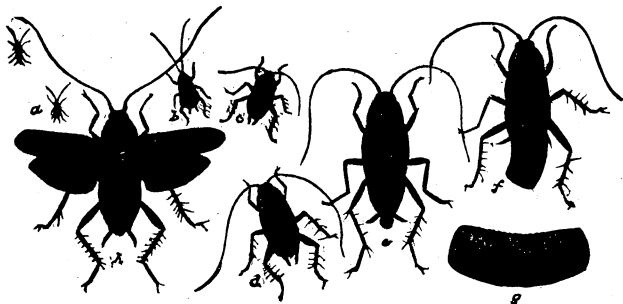


FIG. 5.—The German roach: *a*, First stage; *b*, second stage; *c*, third stage; *d*, fourth stage; *e*, adult; *f*, female with egg case; *g*, egg case, enlarged; *h*, adult with wings spread. All natural size except *g*. (Riley.)

capsules is greatly impaired by the occurrence of another four-winged fly⁷ which is parasitic upon the first. Among other natural enemies of the roach are tree frogs; and a correspondent states that if these animals are inclosed in a room overnight they will entirely clear it of roaches.

REMEDIES.⁸

Like the crows among birds, the roaches among insects are apparently unusually well endowed with the ability to guard themselves against enemies, displaying great intelligence in keeping out of the way of the irate housekeeper and in avoiding food or other substances which have been doctored with poison for their destruction. Their keenness in this direction may be the accumulated inheritance of many centuries during which the hand of man has been ever raised against them. Roaches may be controlled by the use of (1) poisons and repellents; (2) fumigants; and (3) trapping.

POISONS AND REPELLENTS.

As just noted, roaches often seem to display a knowledge of the presence of poisons in food, and, notwithstanding their habit of eating practically all sorts of food, a very little arsenic in baits seems to be readily detected by them. In attempting to eradicate roaches from storerooms in the Department of Agriculture where cloth-bound books are kept, various paste mixtures containing arsenic were tried, but the roaches invariably refused to feed on them in the least. This applies particularly to the German roach, or Croton bug, and may not hold so strongly with the less wary and perhaps less intelligent larger roaches.

⁶ *Evania appendigaster* Linnaeus.

⁷ *Entedon hagenowi* Ratzeburg.

⁸ Minor revision made under this heading, in this edition.

Sodium fluoride.—One of the most effective simple means of ridding premises of roaches is dusting with commercial sodium fluoride, either pure or diluted one-half with some inert substance such as powdered gypsum or flour. Numerous practical tests conducted in lunch rooms, bakeries, milk-bottle exchanges, etc., have shown that with the use of this substance roaches can be completely exterminated with very little trouble and cost and with none of the possible dangers which attend the use of hydrocyanic-acid gas, another efficient means of control referred to under the subject of fumigation. With the use of some dust gun or blower the sodium fluoride can be thoroughly dusted over the shelves, tables, floors, and the runways and hiding places of the roaches. The immediate effect is to cause these insects to come out of their retreats and rush about more or less blindly, showing evidence of discomfort, to be followed in the course of a few hours by their death. These dead or paralyzed roaches can be swept up and burned.

Sodium fluoride acts on cockroaches both as a stomach poison and as a contact poison. Although people have never been known to be poisoned by this powder when it is used as here recommended, several persons have died after eating as much as 1 tablespoonful of it at one time, mistaking it for epsom salts. *It should not be used or kept where there is danger of its getting into food or where children or pets can get access to it.* Sodium silicofluoride, which is also poisonous, may be used as a substitute for sodium fluoride.

Borax.—Powdered borax enters into the composition of many of the so-called roach powders. This substance may be used either pure as a poison or repellent or mixed with some other substance to render it attractive to the insects. Several correspondents have reported great success from the use of a mixture consisting of 1 part powdered borax to 3 parts of finely pulverized chocolate, this mixture to be freely sprinkled about the infested premises.

Pyrethrum.—Another common remedy consists in the liberal use of pyrethrum powder or buhach. This is at best only a temporary expedient, but if persisted in considerable relief will be gained. To be at all effective it must be fresh and liberally applied. The roaches are often paralyzed by it rather than killed outright, and the morning after the application all paralyzed and dead roaches should be swept up and burned.

Sulphur.—Flowers of sulphur dusted about where roaches abound has also proved very effective as a repellent.

Phosphorus.—Of the proprietary substances, perhaps one of the oldest and most efficient is a form of phosphorus paste. It consists of sweetened flour paste containing 1 to 2 per cent of phosphorus, and may be distributed on bits of paper or cardboard placed in the runways of the roaches. It has been used very successfully in the offices

of this department to free desks from Croton bugs, numbers of dead insects being found in the drawers every day during the time the poison was kept about. It also has some repellent value.

All phosphorus pastes are deadly poison if taken internally.

FUMIGANTS.

Hydrocyanic-acid gas.—Hydrocyanic-acid gas fumigation is a thoroughly effective means of ridding premises of roaches, but involves considerable cost, difficulty of application, and the necessity of taking *extreme precautions on account of the deadly effect of the gas on higher animals, including human beings.* A special publication,⁸ which may be had on application, has been issued by the Department of Agriculture giving the steps of the process in detail.

*Carbon disulphide.*⁹—Wherever roaches infest small rooms or apartments which may be sealed up nearly air-tight, and also on ship-board, the roach nuisance can be greatly abated by the proper use of carbon disulphide. This substance, distributed about a pantry or room in open vessels, will evaporate, and, if used at the rate of from 1 to 6 pounds to every 1,000 cubic feet of room space, depending on the tightness of the room, will destroy roaches. As the gas produced is heavier than air and will naturally settle toward the floor, the vessels in which it is exposed should be placed on the upper shelves or highest pieces of furniture. Unless the room can be tightly closed, however, the vapor dissipates so rapidly that its effect will be lost before the roaches are killed. The hatches of ships, especially of smaller coasting vessels, may be battened down, a very liberal application of carbon disulphide having been previously made throughout the interior. If left for 24 hours the roaches and all other pests will unquestionably have been destroyed. *In the use of this substance it must be borne in mind always that mixed with air in certain proportions the vapor is violently explosive in the presence of fire, and every possible precaution should be taken to see that no fire in any form is in or about the premises during the treatment.* It is also deadly to higher animals if breathed in quantity, and compartments should be thoroughly aired after fumigation.

Ethylene dichloride-carbon tetrachloride mixture.—If one wishes to fumigate a room for the destruction of cockroaches and hesitates to use carbon disulphide because of its inflammable and explosive nature, a satisfactory fumigant is a mixture consisting of 3 parts by volume of ethylene dichloride and 1 part of carbon tetrachloride. This produces a gas that is heavier than air and is noninflammable

⁸ Hydrocyanic-Acid Gas against Household Insects. Farmers' Bulletin 699.

⁹ Carbon Disulphide as an Insecticide. Farmers' Bulletin 799.

and nonexplosive. The mixture should be used at the rate of 5 quarts per 1,000 cubic feet of space, and all openings in the room and floor should be thoroughly sealed.

Pyrethrum fumes.—A safer remedy of the same nature consists in burning pyrethrum in the infested apartment. The smoke and vapors generated by the burning of this insecticide are often more effective in destroying roaches than the application of pyrethrum in the ordinary way as a powder. There is no danger of explosion, and the only precaution necessary is to see that the room is kept tightly closed for from 6 to 12 hours.

TRAPPING.

Various forms of traps have been employed very successfully. These devices are all so constructed that the roaches may easily get into them and can not afterwards escape. The destruction of the roaches is effected either by the liquid into which they fall or by being doused with hot water. A few of the common forms of traps and the methods of using them are here described.

A French trap consists of a box containing an attractive bait, the cover being replaced by four glass plates inclined toward the center. The roaches fall from the covering glasses into the box and are unable to escape. A similar trap used in England consists of a small wooden box in the top of which a circular hole is cut and fitted with a glass ring, so that it is impossible for the roaches to escape. This trap is baited nightly, and the catch thrown each morning into boiling water.

A simple and practical method of trapping roaches in large numbers was devised by a correspondent in Brocton, Mass. He took several tin bread pans with nearly vertical sides about 3 inches in height, greased the bottoms and sides with a little rancid butter, and placed them where the roaches were numerous. Each pan in the morning contained hundreds of the pests unable to climb out because of the greased sides. The roaches were shaken out into hot water, and the pans were again ready for use without regreasing.

Traps of the sort described above, placed in pantries and bakeries, unquestionably will destroy great quantities of roaches, and keep them in check and thus obviate the use of insect powders or the distribution of poisoned baits.

**ORGANIZATION OF THE
UNITED STATES DEPARTMENT OF AGRICULTURE**

May 14, 1928

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