

# RAT-CONTROL METHODS

Circular 13

UNITED STATES DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE



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UNITED STATES GOVERNMENT PRINTING OFFICE : 1948

For sale by the Superintendent of Documents, U. S. Government Printing Office  
Washington 25, D. C. - Price 5 cents

# RAT-CONTROL METHODS

## INTRODUCTION

Modern rat-control methods are less a matter of startling new techniques than thorough application of all principles involved. Merely destroying a few rats here and there does not begin to solve the problem, for man has been killing rats for centuries without halting the spreading of these obnoxious pests. Fortunately, we are becoming more and more aware of the deadly effect rats have upon our everyday existence. In thus becoming more rat-conscious, we have an ever-increas-

ing possibility of gaining control of one of the greatest spreaders of disease, death, and destruction the world has ever known (fig. 1).

Permanent control is the only satisfactory solution of the rat problem. Sporadic campaigns to destroy rats, although often effective in reducing the numbers for a short period, must be repeated again and again, with little likelihood of achieving long-lasting results. Any program, to be successful, must incorporate these four major phases of control: De-



Figure 1.—The house rat—spreader of destruction, disease, and death.

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struction of rats, elimination of rat harborages, elimination of food supply for rats, and rat-proofing of buildings. Furthermore, such a program should receive attention at all times of the year. Once initial success has been attained, maintenance is essential, or conditions will soon revert to their former status. A constant watch must be maintained to repel new invaders as quickly as they appear. Complete and wholehearted cooperation of all concerned, public and private, is the keystone to a successful program.

## USE OF POISONS

The most efficient means of effecting wholesale destruction of rats is the use of poisons, or rodenticides, as they are called. Poisons that are deadly for one warm-blooded animal, however, are also more or less poisonous to others. Human beings, pets, and domestic animals must be protected against accidental poisoning. Care must be observed in handling the materials and every precaution taken to avoid contaminating foodstuffs. The poison that best fits the conditions under which it is to be used should be chosen.

### POISONS FOR GENERAL USE

For general use those poisons should be selected that can be used by the average person without difficulty, providing instructions are followed and proper precautions taken at all times. These include red squill, ANTU, and zinc phosphide.

#### Red Squill

Red squill is obtained from the bulb of a lily-like plant that grows in the Mediterranean region. It has the peculiar advantage over

other poisons of containing an emetic agent that causes vomiting in most animals other than rats and thereby the poison is eliminated. Furthermore, it has a disagreeable taste, so that many animals will not touch it. Nevertheless, it is a poison and should be treated as such.

Red squill, as imported, lacks uniform toxicity and often may prove to be an unreliable rat poison unless it has been brought up to uniform strength by an extraction process. Purchasers should insist upon obtaining red squill that has a guaranteed minimum toxicity not to exceed 500 mg/kg (500 milligrams of the toxic element to a kilogram of body weight of the rat). The most satisfactory results are obtained when the poison is mixed with the bait material in the proportion of one to nine; that is, the resulting mixture should contain 10 percent red squill. When dry cereal is used as the base, the red squill should be added to the dry ingredients and the mixture stirred thoroughly before water is added. When meat or fish is used, a thin paste of red squill and water is prepared, care being taken to avoid lumping, and this is then blended with the bait material.

### ANTU

ANTU is the abbreviated name for the chemical alphanaphthylthiourea, which is highly toxic to the common brown, or Norway, rat, but much less so to the black and other forms of climbing rats. For this reason ANTU is not recommended for general use in areas in which the climbing rats predominate, as in the Southern States. ANTU is a grayish-white powder, insoluble in water, chemically stable, and nonirritating to the skin of human beings. It kills rats by causing an accu-

mulation of body fluids within the chest cavity, literally drowning the animals.

Dogs and other pets, pigs, and day-old chickens are easily killed by ANTU. Although many other domestic animals are more resistant to this poison, all precautions should be taken to prevent children, pets, domestic animals, or foodstuffs from coming in contact with it.

Most effective results are obtained when ANTU is used in food baits in a concentration of 1½ percent. It is essential that a complete coverage be made when baiting with this poison. Rats receiving less than a lethal dose build up a tolerance as well as a strong dislike for the material. Operations with ANTU should not be conducted at intervals of less than 4 to 6 weeks. Hence, in a permanent control program in which ANTU is used, it should be alternated with some other effective rodenticide.

### Zinc Phosphide

Zinc phosphide is highly toxic to all forms of animal life, and great care must be exercised in its use. It is a dark gray powder, insoluble in water, and has a strong pungent odor characteristic of phosphorous compounds. Although this poison is well accepted by rats, the odor is, to some extent, unattractive to some animals. Zinc phosphide deteriorates rather rapidly, hence baits treated with it are relatively non-toxic after being exposed several days to the open air. For longer-lasting effects, the baits should be wrapped in waxed paper. As fats and oils increase the absorption of phosphorus in the body, baits composed of these materials give the best results. A small quantity of bacon fat or mineral oil added to the bait mixture will usually prove satisfactory, as well

as make it easier to blend the mixture. A 1-percent concentration of zinc phosphide should be used in the baits.

A number of deaths among human beings have occurred from misuse of phosphorous poisons. In view of the hazards involved, the use of other types of phosphorous compounds and mixtures of the pure element is not encouraged.

### POISONS FOR SPECIAL USE

Poisons consisting of highly toxic substances that are extremely dangerous to all forms of animal life should be used only by trained professional operators.

#### Sodium Fluoroacetate or Compound Ten-Eighty

Sodium fluoroacetate or compound ten-eighty is not sold on the open market. Its use is restricted to insured pest-control operators and to qualified Government technicians. There is no antidote for this poison. It is so toxic that merely one-half ounce is mixed in a gallon of water to make a drinking bait, and a single sip of this preparation will kill a rat. Furthermore, the poison does not disintegrate upon being swallowed. A cat or a dog that eats dead or dying rats that have received this poison will also be killed. Because of this danger of secondary poisoning, compound ten-eighty should not be exposed indiscriminately out-of-doors or in places where pets or domestic animals are kept. Use of this material, except by trained individuals, is not recommended.

#### Thallium Sulphate

Thallium sulphate is another deadly substance not recommended for general use. Although not so toxic as compound ten-eighty, it is tasteless and is readily ac-

cepted by rats. It possesses all the hazards of ten-eighty, and in addition it is cumulative and is capable of being absorbed through the skin. Operators handling thallium sulphate should always wear gloves. Its use should be restricted to trained technicians.

### PREPARATION OF BAITS

Rats are omnivorous; that is, they will eat almost any kind of food available. Like human beings, some individual rats have definite preferences which must be catered to, but, generally speaking, bait materials consist of cereals, meats, fish, cheese, fruits, and vegetables. Any or all of these may be acceptable at any given time. Often a change in the kind of food offered will produce the greatest success. If the rats have been eating poultry feed, baits with a meat or a fish base may yield the best results. On the other hand, occasionally rats will refuse to touch a food they are not accustomed to eating. More important than the materials used, however, is the proper preparation of the baits. Too much poison in the mixture is just as harmful as too little, for acceptance will be cut down. If the poison is not thoroughly mixed with the bait material, some parts of the bait will have too strong a concentration of the poison, while others will have too weak a one to produce results.

Bait material in small lots, up to a pound or two, can be mixed readily by hand, with a large spoon or paddle, in a mixing bowl, pail, or similar container. Articles used in mixing poisons should be used for that purpose only and kept separate from all other utensils. They should be labeled "POISON." Larger lots of bait material are more easily mixed

mechanically. A table-model electric mixer will mix up to about 10 pounds of bait material at a time, a floor model 50 pounds with ease. Mechanical mixing saves labor and results in a more uniform mix than that produced by the hand method. The ingredients should be weighed carefully to insure the proper proportions. No guess work should be allowed. Only enough bait for use on the same day as prepared or within a 24-hour period should be mixed at one time. Baits are most acceptable when fresh. A week's supply should not be made up at one time.

### PLACEMENT OF BAITS

Of greater importance than the kind of bait used, is the proper placement of the material (fig. 2). Rats seek shelter and protection in their movements as far as possible. Baits placed in rat travel-ways and harborages are far more likely to be found and sampled than those exposed in the open. Proper placement is necessary also from the standpoint of safety, if children, pets, and domestic animals are to be protected from exposure to the poisons. Baits should be placed under cover whenever possible. An old board or a box can be leaned against a barn wall to cover a runway. A permanent bait station for exposing the poisoned baits can be made from an inverted box with two 2- by 3-inch holes cut in each end. This has the added attraction of providing harborage when trash piles or other rat shelters are cleaned up. In any event, baits should be placed where rats are and where they are moving, and not merely scattered anywhere at the convenience of the person exposing them.

Of equal importance is the distribution of enough bait. It is better to put out more than is deemed strictly necessary. The





Figure 2.—Place poisoned baits where rats regularly travel.

baits should be made into small balls about the size of a walnut or a marble. Care to prevent the odor of the hands from remaining about the baits or the station need not be taken, as rats are familiar with human scent. Sometimes it may be desirable to wrap the baits in a small piece of tissue or waxed paper. This can be done simply by cutting the paper into 4-inch squares, then folding one square over each bait and twisting the ends. This will keep some baits fresh over a longer period. It also provides a convenient means of handling dry bait mixtures, and affords greater protection to other animals. The main objection to this method is that the rats will often carry the torpedoes, as they are called, back to their nests but will not eat them. When it is desirable that the poisoned baits

should not be carried away, a dry mixture, as corn meal or a feed mixture, may be used and placed in a shallow tray beneath a bait station.

### PREBAITING

The most satisfactory results from poisoning operations are obtained when areas to be treated are prebaited. This consists of exposing fresh, unpoisoned bait materials prepared exactly as the poisoned baits will be later except for omission of the poison. Prebaiting will indicate which foods will be most readily accepted, where baits will best be taken, and how much material will be consumed at a feeding. Often it will prove satisfactory in stubborn poisoning operations, or in cases where previous poisonings have

been unsuccessful. It is a simple procedure, and the extra time thus spent is well worthwhile.

All sources of food for rats should be removed, particular attention being given to such items as garbage cans, stored foods, grain bins, and exposed crates of fruits and vegetables. Trash, piled materials, or other nonfood items should be left where they are until after the baiting has been completed. Runways or burrows should not be blocked, as this might arouse the suspicion of the rats or cause them to move.

It is best to use at least three kinds of food baits so selected as to give the rats a choice of moist or dry foods. The following classes, many of the items of which may be obtained from ordinary kitchen scraps, are suggested:

**Meat:** Ground lean beef, beef melts, liver, sausage, bacon, chicken entrails, or canned meat.

**Fish:** Fresh ground raw fish, canned fish, or cat food.

**Cereals:** Bread crumbs, rolled oats, corn meal, or chicken mash.

**Vegetables:** Sliced tomatoes, green corn, carrots, or lettuce.

**Fruits:** Cantaloups, watermelons, bananas, or apples.

**Miscellaneous:** Peanut butter, sweet chocolate, dried milk, or raw eggs.

Expose the different kinds of bait to be tested in teaspoonful quantities side by side in all spots where rats may be likely to feed upon them. Place baits late in the afternoon or early in the evening, treating the entire area to be covered. Protect the baits from interference by cats, dogs, or persons. Observe the results the following morning, noting the most acceptable bait, locations where the bait was taken, and the

quantity of bait consumed. The exact locations of the most favored baits should be noted carefully, as it is there that the poisoned baits should be placed later. Remove all uneaten baits. If no baits should be taken readily, skip two nights and then repeat the operations with other baits until an attractive one is found.

When the most acceptable bait has been determined, continue the prebaiting with this material for two or three nights in succession to accustom all rats to baits and locations before adding the poison. Be sure to place the poisoned baits in the same spots as the accepted prebaits.

## USE OF POISONOUS GASES

Control of rats by means of poisonous gases includes the fumigation of buildings and structures, and the gassing of burrows. The fumigation of buildings requires considerable preparation and special techniques. It should be attempted only by persons trained for such work, and in many areas the use of poisonous gases is controlled by local regulations. In view of the many hazards and complications involved, its use in rat control, except by professionals, is not generally recommended.

The gassing of rat burrows out-of-doors is an excellent means of control (fig. 3). Many rats are destroyed under ground, so there is no problem of the disposal of the carcasses. Gas has the advantage over poisons of destroying the flea and mite parasites as well, a factor of considerable importance in controlling the spread of some diseases.

The gas most commonly used in rat control is calcium cyanide, in a dust or finely powdered form. It is easily exposed by means of a foot, or stirrup, pump, designed

particularly for the purpose. The nozzle of the hose is inserted in the burrow, the rest of the opening sealed with earth, and five or six strokes of the pump handle provide the initial distribution. If gas is seen escaping from other

holes, these, too, should be sealed, or the rats will escape. The valve on the bottom of the pump is then switched over to "air," and the gas is forced through the entire burrow system. Burrows that have been gassed should always



Figure 3.—Calcium cyanide is forced into rat burrows outside of buildings with a special stirrup pump, as one means of killing rats.

be broken up with a pick or a shovel the next day and the earth tamped down tightly. The remaining rats will reopen the burrows, and these can thus be detected and re-treated until all activity ceases. This method should not be employed to treat burrows in dirt-floored basements or along-side foundation walls where entrance to houses is gained.

Calcium cyanide is a deadly poison and should be used out-of-doors where it is quickly dissipated in the open air. Avoid breathing the fumes. Always pump air through the hose before storing it. The use of calcium cyanide should be curtailed during freezing or rainy weather.

Carbon monoxide, introduced into rat burrows by means of a hose attached to the exhaust of a gasoline motor, has also been used with a fair degree of success. About 5 minutes running time to a burrow will usually suffice. As carbon monoxide is not so swift acting as calcium cyanide, it requires more gas and longer time to take effect.

Carbon dioxide, in the form of dry ice, has been found useful in fumigating refrigerated warehouses where low temperatures must be maintained to prevent food spoilage. The ice is crushed and distributed through the room. An electric fan will speed up the dispersal of the gas. Carbon dioxide is used in about a 15-percent concentration, or 30 pounds to 1,000 cubic feet of space, for 24-hour exposure. It has the advantage of being much safer to handle than are the highly toxic forms of gas.

Other types of poisonous gases are not recommended for general use in rat control.

## USE OF TRAPS

In trapping rats the proper placement of the trap is far more important than the selection of a bait. Rats follow natural runways whenever possible, running along walls and stacked materials, rather than crossing a room in the open. Their instinct for stealth and desire for protection cause them to pass behind anything that is placed or is leaning against a wall. The best baited trap will rarely entice a rat into the middle of a room, but, on the other hand, a rat will frequently pass over a trap placed along a wall rather than detour wide into the open.

Despite its reputation, cheese is not an infallible bait. Bacon strips, a piece of fresh fish, or bacon-scented oatmeal is better. Such baits should be tied firmly to the trigger of the trap to prevent their being taken without springing the trap. Dead rats should not be left to decay in the trap. If this should happen, however, the trap should be scalded with boiling water before reusing, but care need not be taken to prevent human or rat odors from remaining about the trap. A freshly killed rat in a trap will not frighten other rats away, frequently they will even feed upon it. Nor is it necessary to throw a trap away once a rat has been caught in it. If blood or entrails adhere to the trap, they should be scraped off before using it again. The longer a trap is in use, the more likely it is that a rat will approach it.

It is not always necessary to use baited traps. The trigger surface of an ordinary snap trap may be enlarged by using a square of cardboard or a piece of tin, the entire trigger half of the trap being thus made a treadle (fig. 4). A square of corrugated paper,

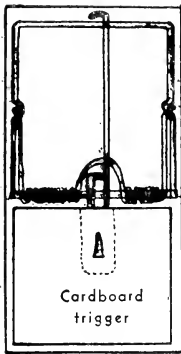


Figure 4.—Triggers of rat traps should be enlarged with cardboard or hardware cloth.

with the trigger forced between the two layers of paper, will also serve. If desirable, a smear of bait can be rubbed on the surface.

Traps with the enlarged trigger surfaces should be placed in such manner as to force the rats to cross over them, as by blocking a runway behind a box or along a beam or a ledge (figs. 5, 6, and 7). When the trap lies flat on a sur-

face, a thin layer of straw or shredded paper can be used to mask it. By using a hose clamp, with a long bolt projection, a trap can be fitted to a pipe by drilling a hole through the trap and fitting it over the projecting bolt (fig. 8). Traps also may be nailed to vertical walls where rats climb to holes or runways (figs. 9 and 10).

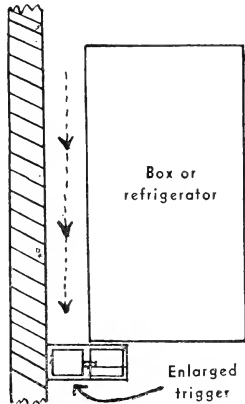


Figure 5.—Traps should be set where rats naturally run.

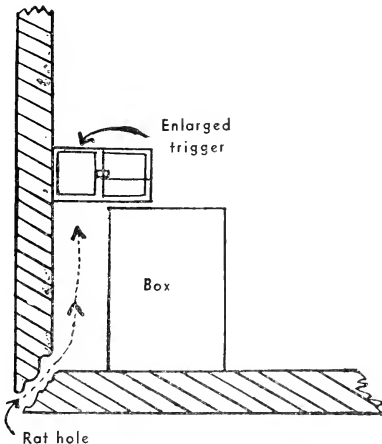


Figure 6.—Boxes or boards often may be placed so as to force rats to cross a trap trigger.

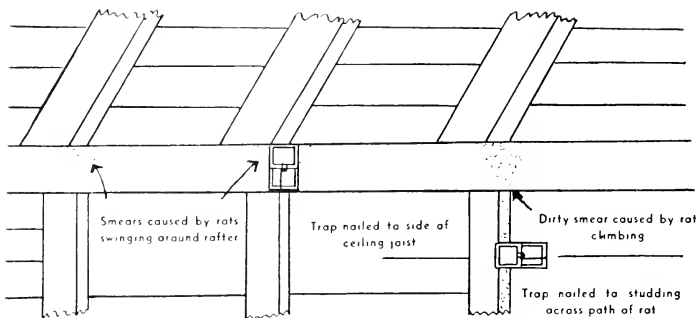
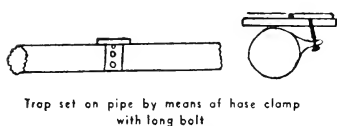


Figure 7.—Traps should be nailed to walls where rats run or climb.



Trap set on pipe by means of hose clamp with long bolt

Figure 8.—A simple device for attaching a trap to a pipe.

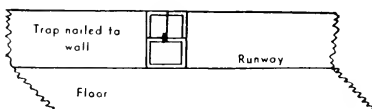


Figure 9.—A trap nailed vertically next to a runway will often catch rats that avoid traps under foot.



Figure 10.—Rat traps often may be nailed to the wall where rat runways are on or near walls. Trigger surfaces should always be enlarged, as shown.

To insure successful trapping operations, plenty of traps should be used. As with bait, considerably more traps should be put out than would seem necessary.

## OTHER METHODS

Many other methods and techniques for killing rats have been advocated, but the three general methods previously discussed give the most satisfactory results. For the most part, other means of destruction are rarely as efficient, or must be relegated to the role of superstition and folklore. Shooting rats, while sometimes an amusing sport, will not achieve control of an entire population. Small terrier dogs and, rarely, cats will kill occasional rats that they find, but cannot rid the premises of the pests. Ferrets, also, have been used to kill rats, but they are too unreliable and destroy too few rats to be a practicable control factor. Such natural enemies as hawks, owls, and snakes should be encouraged to remain about the premises rather than destroyed, but they cannot be relied upon for complete control. Repellents of many kinds have been suggested, but, as they dissipate rapidly, their use is limited to small confined spaces, and even there they must be replenished constantly. Furthermore, they bring about no decrease in the population. Glue boards, based on the same principle as fly-paper, have been prepared, but they are very messy, and besides, rats soon learn to avoid them.

Virus diseases, supposedly capable of starting an epidemic among rat populations, have attracted some interest, chiefly because of the spectacular nature of the method. Those tried, however, have rarely proved effective.

Rats killed by eating the infected food had to be eaten by another rat in order for the disease to be passed on. Furthermore, the bacteria used belong to the same group as the food-poisoning bacilli and have caused some deaths among human beings. Some localities have prohibited the sale or use of the so-called rat viruses. For these reasons, they are not recommended.

There are many other methods that are popularly supposed to be effective in killing rats, but all have proved ineffective. Ever since the dissemination of the legend of the Pied Piper, man has been searching for some easy way to get rid of rats. The sooner it is realized that downright hard work is the only solution, the sooner adequate control will be attained.

## REMOVAL OF RAT HARBORAGES

Unless the places in which rats are living are destroyed and potential habitations broken up, control methods are rarely successful. Rats can always find enough food available to sustain life. As long as a place to hide and rear young exists, they will continue to survive. Studies have shown that after a poisoning campaign the rat population will regain its former numbers within about 9 months or less if no other control measures are undertaken.

The common brown rat lives underground, beneath stored materials, behind double walls, and in other similar enclosed spaces. After a thorough poisoning program, these harborages must be eliminated as far as possible. All burrows should be broken up. Stored materials should be placed on racks 12 to 18 inches off the ground (fig. 11). If the woodpile

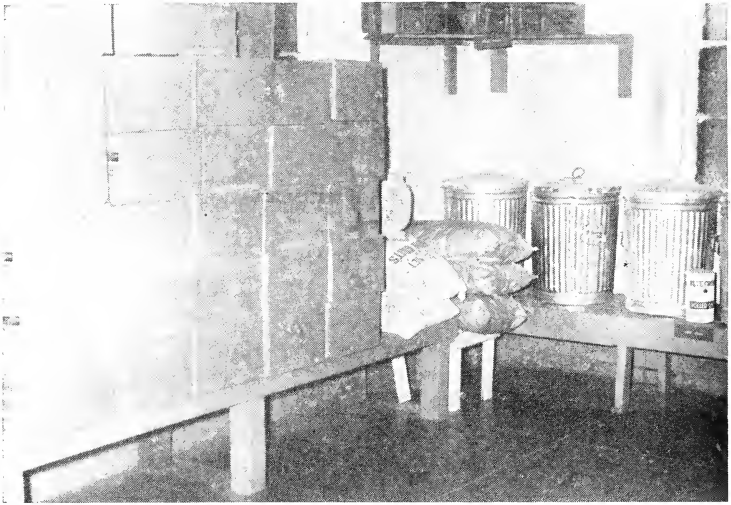


Figure 11.—Food and supplies subject to rat damage should be stored on racks high enough to eliminate harborage and permit easy cleaning.

is already stacked for the winter, however, racks for keeping new supplies off the ground should be built. Piles of rubbish and discarded material should never be allowed to accumulate. If materials are stored in a dirt-floored shed, they should be kept neatly on shelves or racks, not piled on

the floor. If they are worth keeping, they are worth proper storage care. Double walls, made of wall-board or other insulating material, are favorite harbors for rats. They should be eliminated. If insulation is needed, insulating board can be nailed directly to the wall between the studding. Re-



Figure 12.—Hardware cloth is useful in excluding rats from openings that cannot be closed with brick or mortar.



removal of these breeding spots not only deprives any remaining rats of a place to live, but renders the place unattractive to any new rats that may stray in.

## RATPROOFING

Once the bulk of the rat population has been destroyed and the harbors eliminated, it becomes necessary to make the buildings as ratproof as possible in order to prevent reinfestation (fig. 12). Cement, hardware cloth of  $\frac{1}{4}$ -inch or  $\frac{1}{2}$ -inch mesh, and sheet metal of 26 gage or heavier are all good ratproofing materials. The exte-

rior of the building should be carefully examined. All openings larger than  $\frac{1}{2}$  inch must be closed if rats are to be kept out. Wooden sills and doors at ground level should be sheathed in sheet metal to prevent their being gnawed (fig. 13).

Windows less than 4 feet off the ground in places where brown rats are present, and at any height from the ground where the climbing rats are prevalent, must be screened with hardware cloth. Foundation walls, particularly where utility lines enter the building, should be checked for openings and pointed up with cement.



Figure 13.—Edges of doors or other openings where rats gnaw should be protected with metal sheathing.

If rats burrow beneath a foundation to enter a building, it would be well to install a curtain wall in the shape of an "L" 2 feet deep and 1 foot across the footing. Rats will tunnel down 3 or even 4 feet, but rarely will they cut around the footing. Almost any structure can be made ratproof with a little ingenuity, and usually any measures so taken will at the same time result in useful and worthwhile repairs to the building itself. In the case of open buildings, as barns and sheds, it is largely a matter of making certain that no harbor is present, so that if a rat does run through the place, it will have no place to hide.

## GENERAL SANITATION SUGGESTIONS

Food and shelter are the two most important factors in a rat's existence. It hunts for a food supply and for a convenient harbor-age nearby. Eliminate these two attractants and the premises lose their appeal to rats. Ignore them and new invaders will appear as fast as the old ones are killed off, particularly if nearby areas are also undergoing a control program. Open garbage and trash heaps should not be permitted. Care should be taken not to spill food on the ground and leave it for rats to get. If birds are being fed,

a rat-proof feeding tray placed on a generous ledge to prevent spilling should be provided. In cities, particularly, often more food goes to rats than to the birds. Un-sightly dumps should be eliminated. If complete burning is not possible, the debris should be buried at least 3 feet deep and the earth compacted around it. Every week should be a "clean-up week."

## MOUSE CONTROL

In general, the control of mice is based on the same techniques as those used in the control of rats. Trapping, unless the infestation is heavy, will often be sufficient. Of the poisons mentioned, ANTU and red squill give poor results. Zinc phosphide and strychnine alkaloid are more satisfactory. Again, it must be emphasized that care must be observed in the proper handling of the materials, that a sufficient quantity of the materials be used to insure satisfactory results, and that sanitary measures be taken to eliminate conditions that permit the pests to exist. Detailed information on the control of mice can be found in United States Department of the Interior Conservation Bulletin 36, Control of Destructive Mice, which can be obtained from the Fish and Wildlife Service, Washington 25, D. C.

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