

Chapter 23

CONTROL OF ARTHROPODS AND RODENTS OF MEDICAL IMPORTANCE

Responsibility

The responsibility for arthropod and rodent control is divided between the Medical Services and the Civil Engineering Services. AFRs 161-1 and 91-21 define these responsibilities. In general, the Base Civil Engineer plans, initiates and supervises arthropod and rodent control activities, whereas the Director of Base Medical Services has primarily survey and advisory responsibilities. The Medical Service responsibilities may be listed briefly as follows:

- a. To watch closely over adjacent communities to detect vector-borne diseases.
- b. To make frequent periodic on-base surveys to determine the presence of vectors of arthropod or rodent-borne diseases, or of pest species.
- c. To recommend to the Base Civil Engineer that appropriate control programs be initiated when surveys demonstrate the presence of disease vectors or of pest species adversely affecting morale.
- d. To furnish advice on control measures and chemicals to be used.
- e. To monitor the effectiveness of control programs for vectors and pest species.
- f. To assist in instructing vector control personnel concerning toxicity, safe handling and application of insecticides.
- g. To assist in instructing all military personnel regarding personal protective measures.

Surveys

Thorough field surveys must be made to determine the presence of disease vectors or pest species, and, if present, whether the populations of these species are large enough to warrant area-wide control programs. The initial base survey is best made by an

entomologist trained in survey methods and the identification of vector and pest species. Consultant services for the initial survey in the CONUS and Alaska should be requested from the USAF Epidemiological Laboratory (see AFR 161-21) or in overseas areas, from the 4th Epidemiological Flight in USAFE or the 5th Epidemiological Flight in PACAF (see AFR 161-12).

Periodic and continuing surveys and monitoring of the efficiency of routine control programs should be made by the Director of Base Medical Services in accordance with procedures recommended by the medical entomologist during his initial base survey. AFM 85-7 contains a brief summary of survey methods. Surveys should be continued at weekly intervals during the warm months, or throughout the year in tropical areas.

Identification

Successful control programs can be planned only when the vectors and pests have been accurately identified, and when information is available on their life history, breeding sites and bionomics.

Identification requires technically trained personnel who are not available at the average Air Force hospital. Specimens for identification should be sent to the USAF Epidemiological Laboratory, to the 4th or 5th Epidemiological Flights, or to the nearest Army Area Medical Laboratory per AFR 160-62. Information on life history and bionomics will usually be available from medical entomologists, but delineation of the breeding areas will have to be made at the base level.

In general, adult mosquitoes and other flies of medical importance should be submitted for identification in pill boxes between

layers of kleenex or toilet paper. Most other medically important arthropods and larvae of mosquitoes and flies should be preserved and shipped in 70% grain alcohol in vials. Adequate data as to locality and date of capture should be included with each sample sent for identification. Specimens should be preserved and mailed in accordance with "Collection and Preservation of Insects," Misc Publ 601, US Department of Agriculture. Free copies are available from that agency upon request.

Control

The two general types of arthropod and rodent control measures employed in the Air Force are physical and chemical.

a. Physical control measures are often more expensive initially, involve more personnel and require more planning. Physical measures are aimed at removal or denial of breeding areas, harborage and food. They are more effective than chemical controls, and are less costly in the long run.

b. Chemical control measures are temporary in nature, and although they can be carried out quickly by a minimum of personnel, they are less effective than permanent physical control methods, and more expensive over a long period. Chemical measures are usually easier to carry out while the insects are in one of the young stages. Many arthropod eggs are laid in batches in small areas and the young are thus concentrated. Such concentration makes it easier and cheaper to kill large numbers of arthropods with less insecticide and labor than if the adults are attacked later. Some, however, are not accessible until they are full grown, and must be controlled by direct attack of the adults.

c. If control by chemical means is selected, the utmost care must be exercised to insure that only approved insecticides are used, that insecticides are employed safely and at the recommended dosages. If properly applied at the recommended rates, the chance of damage to wildlife is minimized.

d. Recommended insecticides and dosages are subject to frequent changes as new

compounds are made available or as resistance is developed by insect species. The Communicable Disease Center, USPHS, Savannah GA 31401, publishes a useful annual report, "Public Health Pesticides," copies of which are available from that agency. The Armed Forces Pest Control Board issues periodic revisions of Technical Information Memorandum No. 6, "Current Pest Control Recommendations." The Disease Vector Control Centers (DVCC), US Navy, periodically revise "Recommendations for Chemical Control of Disease Vectors and Economic Pests."

The US Public Health Service (USPHS) and DVCC publications on vector control list both standard and nonstandard pesticides. Air Force users are cautioned to requisition and apply only pesticides listed in Military Supply Standard, Class 6840.

General

a. In order to avoid classification problems, ticks, mites, and some venomous arthropods are included under the term "insects"; although they are not true insects at all.

b. The insects may be divided into two general groups; beneficial and harmful.

(1) The beneficial insects include scavengers which rid us of organic waste material; the parasites and predators which help in the fight against harmful insects; and the pollinators. These groups are so important economically that great care must be taken to avoid their destruction in any large control operations.

(2) The harmful insects fall into three groups: economic, pest, and medical.

(a) Economically harmful insects include those which destroy crops, forests, food and clothing, and which affect the health of cattle and pets. The control of these insects is of minor importance on a military base, such work frequently being the responsibility of federal and local departments of agriculture.

(b) Many pest insects have no particular economic or health importance to

man, but are a great nuisance, and may affect morale.

(c) There are many insects involved in the transmission of diseases to man, mosquitoes being the most widely known group. Of 126 diseases communicable to man, 61 are entirely or partially insect-borne.

DISEASE VECTOR CONTROL

Mosquitoes

Diseases and Vectors:

Malaria—*Anopheles quadrimaculatus* and other *Anopheles* spp.

Yellow fever—*Aedes aegypti*, *Haemogogus* spp.

Dengue fever—*Aedes* spp.

Encephalitides—*Culex* and *Aedes* spp.

Filariasis—*Culex*, *Aedes*, *Mansonia* and *Anopheles* spp.

Breeding:

Eggs laid in or near water; the larvae ("wigglers") and pupae ("tumblers") are aquatic; may be found in ponds, puddles, streams, marshes, tree-holes, cow-hoof holes and artificial containers such as tin cans, old tire casings, flower vases and gutters.

Control:

Physical. Draining of water; filling ponds and other breeding areas with dirt; removal of artificial breeding areas; ditching of swamp and marsh areas; screening of buildings.

Chemical:

Adults:

Indoors. Space spray with synergized allethrin aerosol at a rate of 7 seconds per 1000 cubic feet. Residual spray with 2.5 to 5% DDT at 1.0 gallon per 1000 square feet; if resistance has developed to this chlorinated hydrocarbon insecticide, use 2 to 5% malathion at 1.0 gallon per 1000 square feet. Residual sprays are applied to the point of runoff.

Outdoors. Apply 5 to 10% DDT or 6% malathion oil solutions at a rate of 40 gallons per hour at 5 mph as a fog or mist, or 5% malathion dust at a rate of 6 lbs per acre; this affords temporary relief only.

Larvae:

Ground Applications. 1.0% emulsions or oil solutions of chlordane or dieldrin at a rate of 0.1 lbs of toxicant per acre or of DDT at a rate of 0.2 lbs of toxicant per acre; where resistance to chlorinated hydrocarbons has developed, malathion oil solution or granules may be used at a rate of 0.2 lbs of active ingredient per acre (0.5 lbs may be used in nondraining areas where there is no hazard to wildlife).

Aerial Spraying. Applications are made by the Special Aerial Spray Flight (SASF), HQ TAC; requests should be processed per AFR 91-22; aerial spraying should be done only when effective control cannot be obtained by conventional ground applications.

Personal Protection. Use of skin or clothing repellents; head nets may be used in areas where heavy concentrations of pest species are present; mosquito bars should be used by personnel sleeping outdoors or in unscreened buildings.

Flies

Diseases and Vectors:

Typhoid fever—*Musca domestica* (housefly) and others.

Cholera—*M. domestica* and others.

Dysenteries and diarrheas—*M. domestica* and others.

Tularemia—*Chrysops discalis* (deer fly).

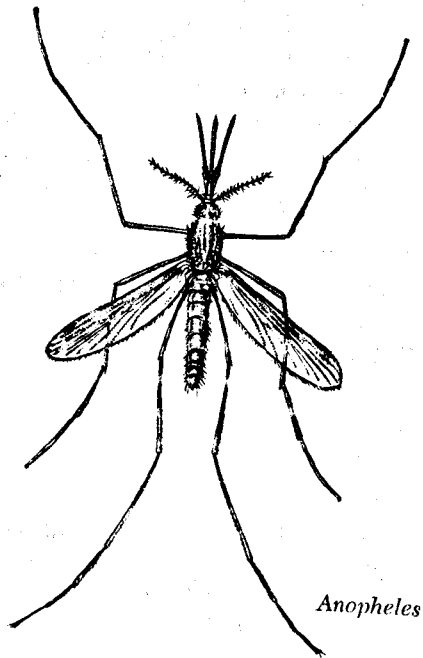
Leishmaniasis—*Phlebotomus* spp. (sand fly).

Trypanosomiasis—Tsetse fly.

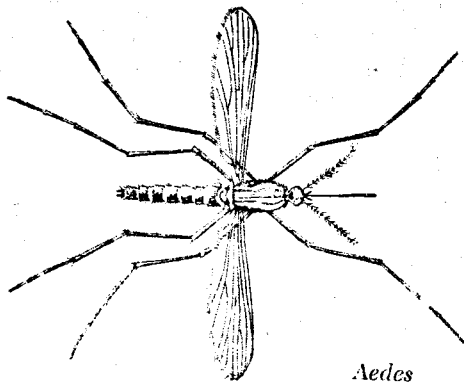
Fly-borne diseases may be transmitted by mechanical means, as are the intestinal diseases and tularemia. Others are transmitted only after completion of part of their life cycle in the fly, as is trypanosomiasis.

Breeding:

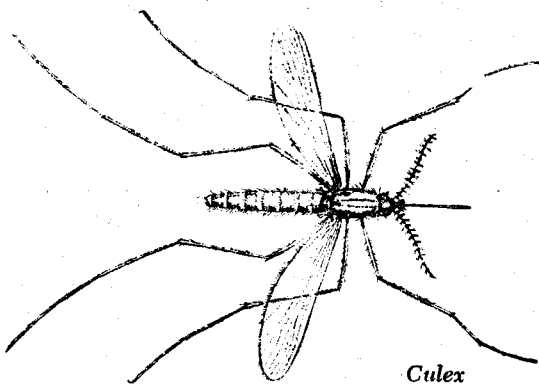
Houseflies and other "filth-flies"; in manure, garbage, spillage and other organic material. Other flies: varied; the deer fly breeds in soil at the edge of streams; the true sand flies in cracks and crevices, and in rock walls. The breeding habits of flies are so varied that the life history of the individual



Anopheles

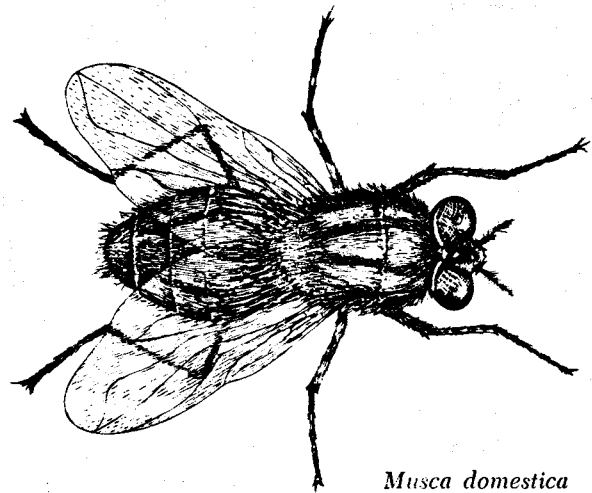


Aedes

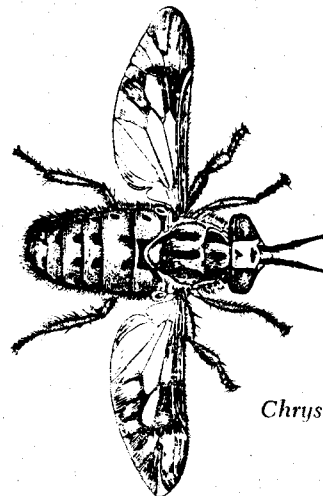


Culex

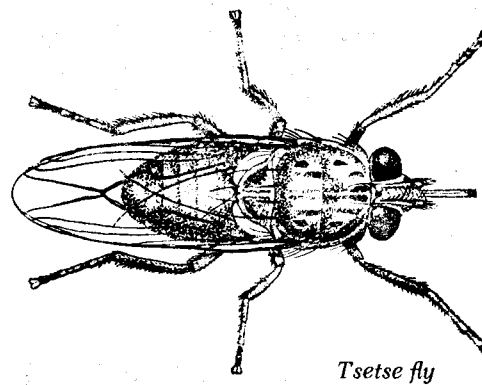
Figure 23-1. Mosquitoes.



Musca domestica



Chrysops discalis



Tsetse fly

Figure 23-2. Flies.

species must be known for permanent control.

Control:

The nearly universal resistance of houseflies and blowflies to chlorinated hydrocarbons, and the rapidly developing resistance to organic phosphate insecticides emphasizes the necessity for good sanitation in fly control.

Physical. The proper operation of incinerator or sanitary fill for garbage disposal; proper handling of garbage at messhalls; proper sewage disposal; and screening of buildings.

Chemical:

Indoors. As a residual treatment use an oil emulsion containing 1.0% diazinon or 5.0% malathion applied as a spot treatment to the point of runoff (1 gallon per 1000 square feet).

Outdoors. Baits for use outside messhalls may be prepared from 1 fluid ounce of 47.5% emulsifiable diazinon plus 3 lbs sugar in 3 gallons of water, or 2 lbs of 25% malathion wettable powder plus 23 lbs sugar. Space sprays may be used at rate of 5 gallons 57% malathion emulsifiable concentrate in 41 gallons water at a rate of 20 gallons per mile or 6 gallons 47.5% diazinon emulsifiable concentrate in 39 gallons water at a rate of 15 gallons per mile. Residual sprays may be used on inner walls of pit-type latrines, but pit contents should not be treated since this eliminates breeding of desirable scavenger species.

Fleas

Diseases and Vectors:

Bubonic plague—*Xenopsylla cheopsis* (Indian rat flea) and others.

Murine (endemic) typhus—*Xenopsylla cheopsis*.

Sylvatic plague—Many species from wild rodents.

Breeding:

Eggs are laid in the nest or bed of the host, or in the host's fur or feathers. In the latter case, they usually fall to the ground or to the nest. The larvae are very active, crawling around the nest or bedding ma-

terial, or on rugs, on the floor, or on the ground.

Control:

On host animals. Dust dogs and cats with 5% malathion or 0.2% synergized pyrethrum dust; 1% lindane and 2 to 4% chlordane dusts may be used on dogs only.

Treat bedding and resting places of pets at same time. Infestations in buildings may be controlled by 1% malathion spray or 4 to 5% malathion dust. In yards, treat ground with 1% diazinon or 2% malathion emulsion at 1 gallon per 1000 square feet, or 4 to 5% malathion dust at 1 to 2 lbs per 1000 square feet.

Lice

Diseases and Vectors:

Epidemic typhus fever—*Pediculus humanus*.

Relapsing fever—*Pediculus humanus*.

Dermatitis—*Phthirus pubis* (crab louse) and *Pediculus humanus*.

Breeding:

Body louse. This subspecies of *Pediculus humanus* breeds, lives and lays eggs primarily in the seams of the clothing.

Head louse. This subspecies mainly inhabits the head hair and head gear, the eggs, or nits being laid on the hair.

Crab louse. Found primarily in pubic region, but may spread to hair of chest and axilla, and even to the head. Occasionally found on toilet seats or bedding. This species seldom goes to the clothing, but remains attached to the body hair.

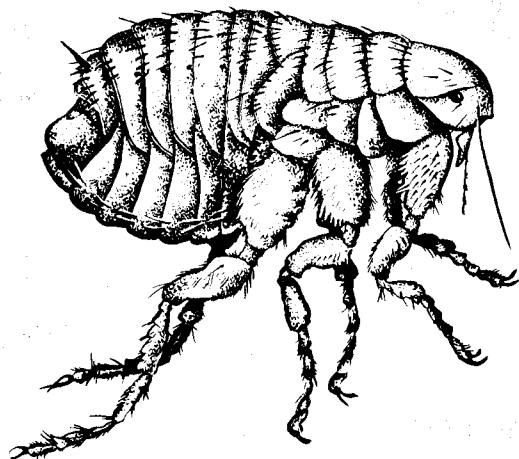
Control:

Ten percent DDT or 1% lindane dusts may be applied to body parts and to clothing; where resistance to chlorinated hydrocarbons is encountered, a 1% malathion dust is recommended. Good personal hygiene, including frequent baths and laundering of clothing, is imperative. Personnel should not bathe for 8 hours after treatment with insecticide.

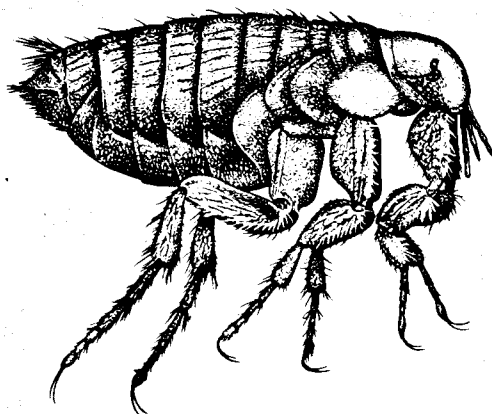
Ticks (Not Insects)

Diseases and Vectors:

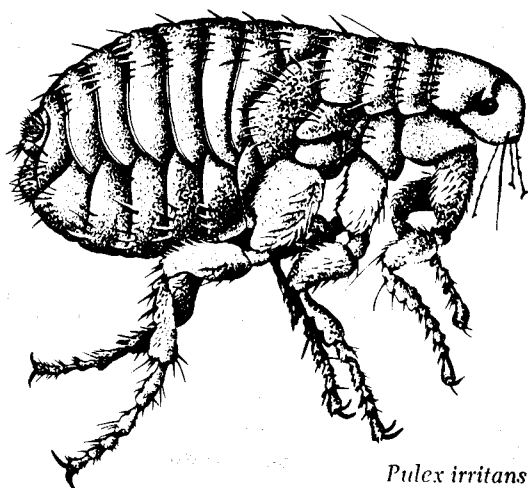
Tularemia—*Dermacentor andersoni*, *D. variabilis*, *Amblyomma americanum*, others.



Xenopsylla cheopsis

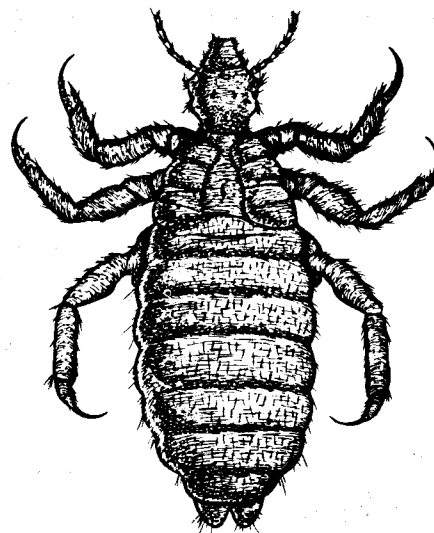


Nosopsyllus fasciatus

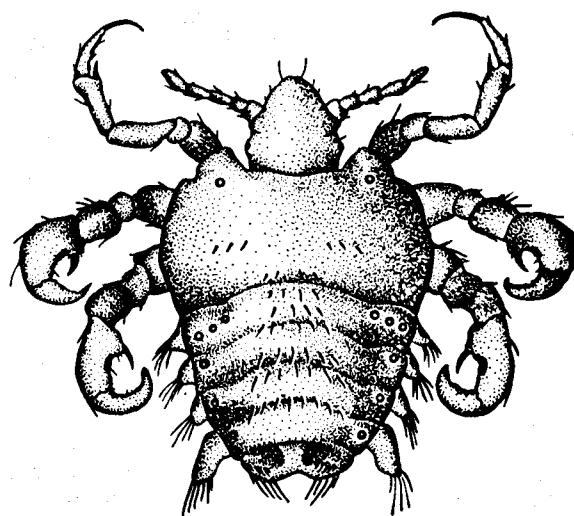


Pulex irritans

Figure 23-3. Fleas.



Pediculus humanus



Phthirus pubis

Figure 23-4. Lice.

Relapsing fever—*Ornithodoros* spp.; others.

Encephalitides—*Dermacentor* spp. and *Ixodes* spp.

Rocky Mountain spotted fever—*Dermacentor andersoni*, *D. variabilis*, *Amblyomma americanum*; others.

"Q" fever—*Dermacentor andersoni*, *D. occidentalis*, *Haemaphysalis humerosa*, others.

Tick paralysis—*Dermacentor andersoni*, *D. variabilis*.

Breeding:

Ticks are ectoparasites, feeding on various animals. After each feeding they drop off and molt, then await a new host. Some species feed only once a year and require a different kind of animal host for each feeding. The species that attack man are usually found in grassy or wooded areas. These species climb up the outside of the clothing and usually attach on the back of the neck.

Control:

Personal. Skin (diethyltoluamide) and clothing (M1960) repellents; personal body inspection and removal of attached ticks.

Animals. Dip or sponge pets in 0.5% lindane or 0.5% malathion solution, or dust with 4% malathion; lindane should not be used on cats.

Area. Spray or dust applications of DDT, chlordane, and dieldrin at 1 to 2 lbs active ingredient per acre or BHC at 0.5 lbs of gamma isomer per acre. Avoid treatment near streams at the higher concentrations because of toxicity to aquatic life.

Building. Spot treatment of infested areas with diazinon as a 0.5% emulsion or solution, or spray with 1 to 2% malathion at a rate of 1 to 2 gallons per 1000 square feet. Do not use diazinon on animals.

Mites (Not Insects)

Diseases and Vectors:

Scrub typhus—*Trombicula akamushi*, *T. deliensis*.

Rickettsial pox—*Allodermmanyssus sanguineus*.

Endemic (murine) typhus fever—*Bdellonyssus bacoti*.

Scabies (7-year itch)—*Sarcoptes scabiei*.

(Mites are also important pests of man—i.e., "chiggers" or "redbugs," and various species of bird mites and rat mites that occasionally swarm in houses.)

Breeding:

The mites of medical importance to man are parasitic in at least one stage of their development. In general, they are found either on a host animal or in grass or other vegetation. Control is thus dependent upon the species involved. The mites that carry endemic typhus are found on rats or in the rats' habitat. The mites that serve as vectors of most other diseases are usually found on grass or on organic matter such as leaves, mold and dead logs.

Control:

Personal. Skin (diethyltoluamide) and clothing (M1960) repellents.

Area. Spray or dust treatments of chlordane (1 to 2 lbs per acre), lindane (0.25 to 0.5 lbs per acre) or dieldrin (0.6 to 1.0 lb per acre). Avoid treatment near streams at the higher concentrations because of toxicity to aquatic life.

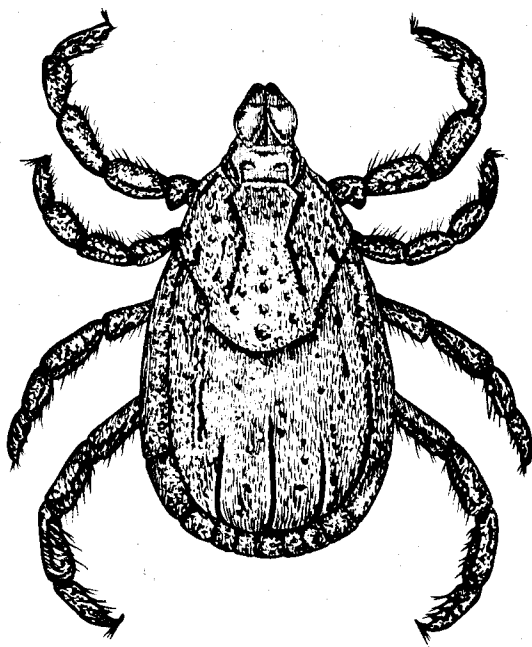
PEST INSECT CONTROL

The pest insects include those which do not carry disease. Many insect groups contain both disease-carrying and pest members. Such groups have already been covered in preceding sections if they are of importance as disease vectors.

Cockroaches

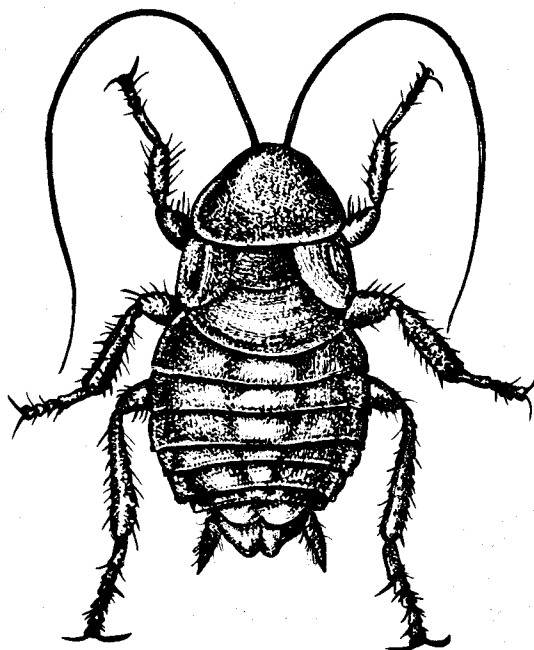
Breeding:

Cockroaches (*Periplaneta americana*, *Blattella germanica*, *Blatta orientalis*, and others) live in cracks and crevices in walls, cupboards, and around water pipes. Some species carry the egg sacs until hatching occurs while others glue the egg sacs to the underside of drawers and shelves. Roaches can travel easily within buildings, even those which are partitioned off into sections, and are often spread to new areas with groceries and other packages.

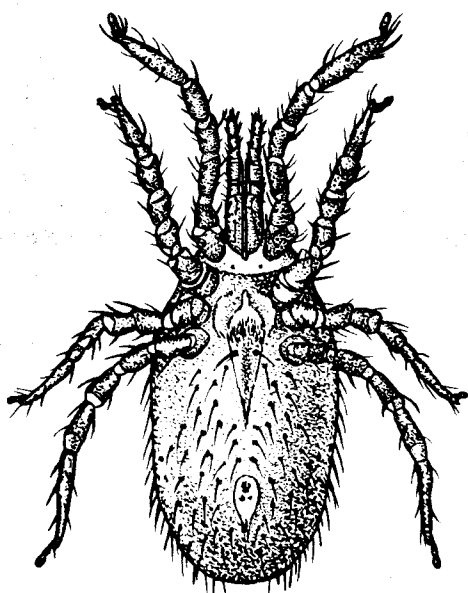


Dermacentor variabilis

Figure 23-5. Tick.

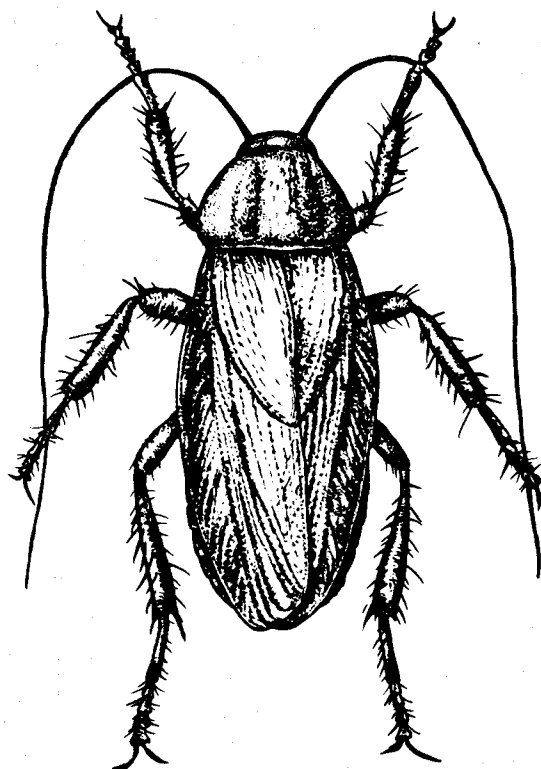


Blatta orientalis



Allodermanyssus sanguineus.

Figure 23-6. Mite.



Blattella germanica

Figure 23-7. Cockroaches.

Control:

Physical. Proper, tight construction of new buildings coupled with scrupulous cleanliness can virtually eliminate cockroaches.

Old buildings can be made somewhat "cockroach-proof" by sealing cracks, crevices and pipe holes with putty, woodfiller, plaster, or concrete.

Chemical. Insecticides for cockroach control should be applied as "spot-treatment," placing small amounts in cracks, corners, under cupboard drawers, behind refrigerators and in other hiding places.

Use coarse spray of 3% chlordane or 0.5% dieldrin as a spot treatment; 1% malathion spray for populations resistant to chlorinated hydrocarbons; or combination of 0.5% diazinon spray and 2% diazinon dust. Second application should be made about a month later; subsequent applications at 3-month intervals should control infestations satisfactorily.

Bedbugs**Breeding:**

Bedbugs (*Cimex lectularius*) breed in cracks and crevices in walls, in beds, and in the spaces along the rolled edges of mattresses. They are frequently picked up on trains and buses, and in theaters and hotels. Bedbugs bite at night, and then retire to their hiding places. Often, the only sign of their visit is the presence of bites, or of tiny blood spots on the bedding.

Control:

5% DDT in colorless, odorless kerosene, sprayed on mattresses and beds, and in cracks and crevices on base boards, floors, and walls at a rate of 1 gallon per 1000 square feet. All rooms in the building should be sprayed unless the building is too large to make this practical; in this case, rooms in and near the infested area should be sprayed. 1% malathion at the same rate may be used if DDT proves ineffective. 0.5% lindane will give control if other chemicals fail, but should not be used on mattresses.

VENOMOUS ARTHROPOD CONTROL

Venomous arthropods are of importance because of their bite or sting, which may produce local symptoms or even death.

Black Widow Spiders—(*Latrodectus mactans*)

The black widow is the only spider in the United States whose bite is poisonous to man. Deaths occur mainly in males, who are bitten in the genital region, while using outdoor privies. Danger is also great among infants and the very aged.

Breeding:

Black widows breed in lumber piles, stumps, trash piles, undersides of privy seats, cracks and crevices in and under houses, and under old lumber, roofing material, cans and other pieces of trash on the ground.

Control:

Physical. The best control is through the cleaning-up of breeding areas. Trash should be disposed of only at dumps, where it can be covered or burned. Education of personnel should not be overlooked.

Chemicals. 5% chlordane dust is excellent for chemical control; oil sprays containing 2% chlordane, 0.5% lindane or 3% malathion may also be used. The insecticides should be applied to inner walls of privies and other breeding areas at regular intervals, the time to be determined by survey.

Scorpions—(*Centruroides sculpturatus* and others)

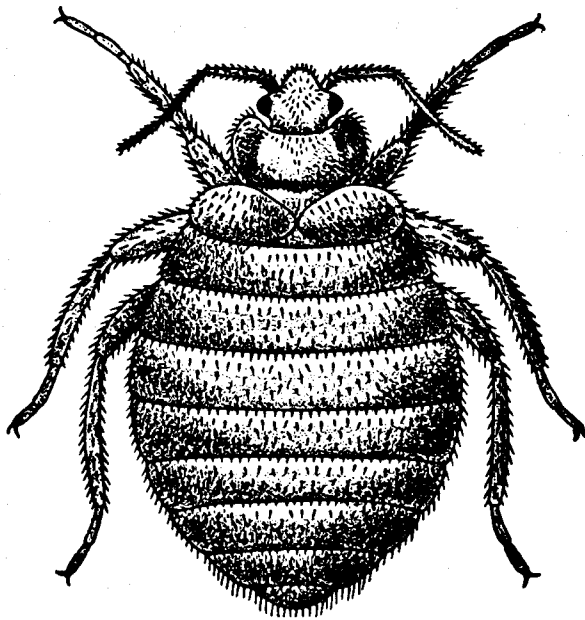
There are about 50 species of scorpions in the United States, but only one Arizona species is known to cause death in man. The toxin is carried in the stinger, being injected by a downward thrust of the tail.

Breeding:

Scorpions are usually found under stones, in decaying wood, and under trash piles, while some Southwestern species may hide in sand. They often invade houses and tents, hiding in dark corners, under furniture, and in shoes.

Control:

Education of personnel in the methods of avoiding contact offers the best means of combating scorpions.



Cimex lectularus

Figure 23-8. Bedbug.

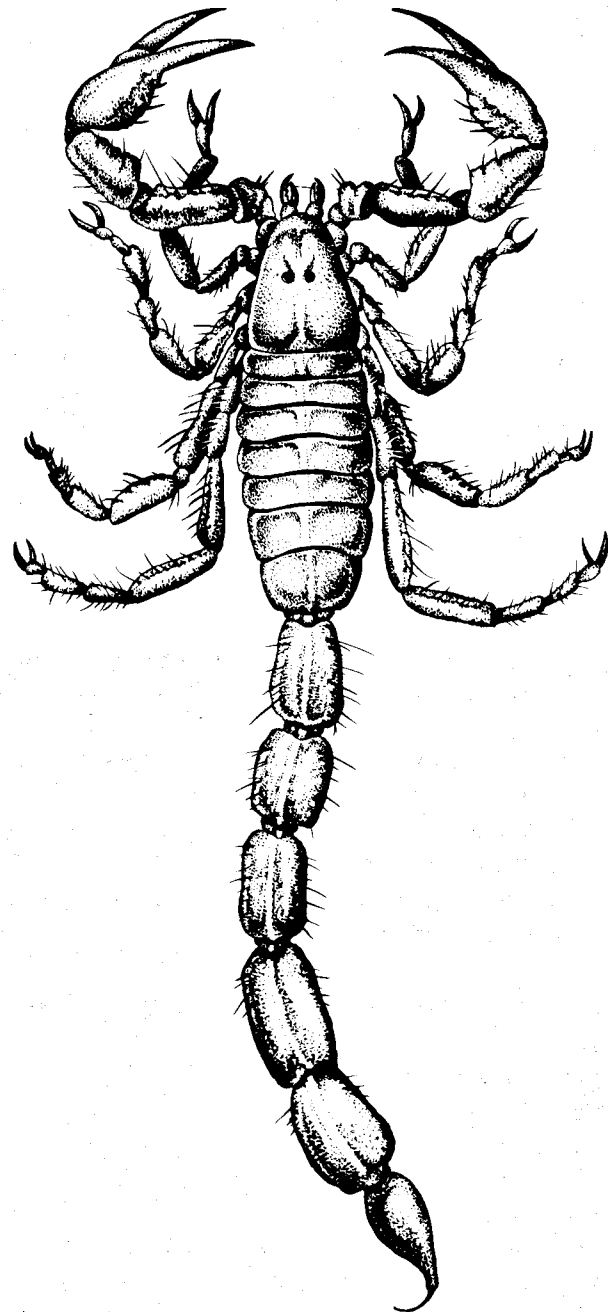
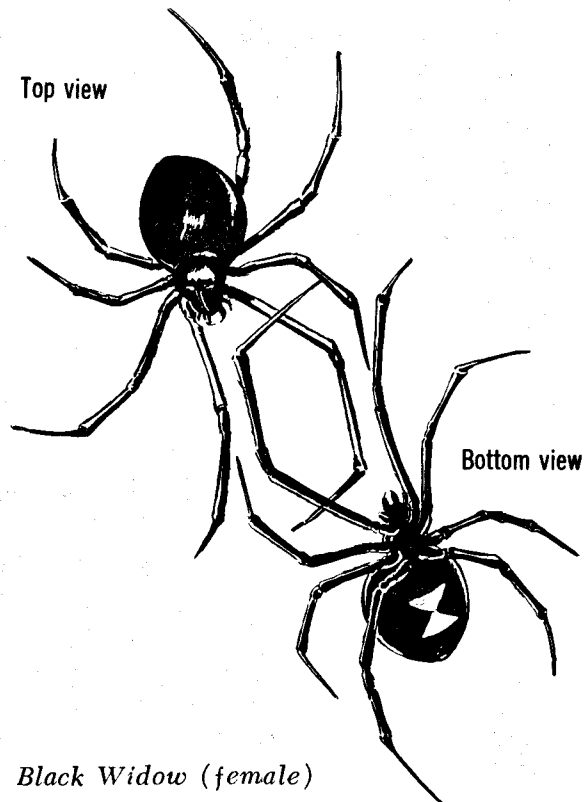


Figure 23-10. Scorpion.



Black Widow (female)

Figure 23-9. Spider.

Physical. Cleaning and clearing of possible hiding places.

Chemical. Indoors, spray with emulsion containing 2% chlordane or 0.5% dieldrin at a rate of 1 pint per 125 square feet; outdoors, use the same spray as required.

Wasps and Bees

There are many species of wasps and bees which can inflict painful stings. The venom sometimes produces severe systemic or allergic reactions that occasionally result in death through anaphylactic shock. The social wasps (hornets, yellow jackets and paper wasps) and social bees (honeybees and bumblebees) are particularly dangerous because they will attack in numbers if their nests are disturbed. Some solitary species whose stings have been reported as causing severe reactions are sweat bees, mud dauber wasps, velvet ants, and bethylid wasps. The solitary species are not aggressive in defense of their nests; ordinarily they will sting only when handled.

Breeding. Hornets build large paper multi-combed nests in trees or bushes, or in the sidings of houses; yellow jackets build similar paper nests in the ground; and paper wasps build umbrella-shaped, single-combed nests in protected situations such as under porch roofs, house eaves, etc. Colonies of wild honeybees may nest in hollow trees or in sidings of houses. Bumblebee nests are usually found on or just below the ground surface, or, occasionally, in abandoned birds nests. The solitary wasps and bees are quite diverse in their nesting habits; some build clay cells in sheltered situations, some nest in borings in wood, and still others nest in the ground.

Control:

Physical. Mud-dauber nests may be knocked off the building where they are attached. It may be necessary to apply a residual spray to discourage further nesting at the site.

Chemical. Control procedures against social wasps and bees are best undertaken at night when the insects are not active. Colonies in underground nests and those in

the siding of houses may be destroyed by fumigation with a nonflammable substance such as chloroform or carbon tetrachloride; half a cupful should be poured into the nest opening and then the opening should be plugged with earth or a tight plug of absorbent cotton; precautions should be taken so that personnel are not exposed to the fumes. Populations in aerial nests may be destroyed by directing a dust of 5 to 6% chlordane, 1% dieldrin or 5 to 10% DDT into and around the openings, or spray with a 2% chlordane, 5% DDT or 0.5% dieldrin oil solution; or, aerial nests may be dislodged, placed in a sack and buried or treated with fumigant in a garbage can. Aggregations of ground-nesting wasps and bees may be destroyed by spot treatment of the nest openings with a dust containing 5 to 10% DDT, 5 to 6% chlordane or 1% dieldrin. Occasionally, wasps may enter attics or cellars in large numbers in the fall to hibernate; they may be killed with the allethrin-DDT aerosol bomb.

Urticating Arthropods—(Various species)

There are a number of beetles and other arthropods which produce blisters if handled or touched. In addition, the caterpillars of various moths can produce a severe dermatitis upon contact.

Control:

Control measures depend on accurate identification. The local Health Department, or local Department of Agriculture can usually identify and recommend control measures for these pests.

Tarantulas—(Eurypelma spp.)

Tarantulas are large hairy spiders. They are widely feared, but are not poisonous to man, although they can inflict a painful bite.

Control:

Control of tarantulas is similar to that of spiders and scorpions.

Control of Other Insects

There are many other insects that may be of importance on air bases. Control measures for many of these can be found in AFM 85-7. Control of unknown insects must be based on

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identification of the insect by the USAF Epidemiological Laboratory, Epidemiological Flights, or the Army Area Medical Laboratory.

RODENTS

Rats are the rodents of primary importance in most areas. However, there are many Air Force installations in areas where mice and other rodents are the principal problem. Rodents, of course, are of great economic importance as destroyers of food and property, but their main interest to the Medical Service lies in their disease-carrying potentialities.

Rodents are involved in disease transmission in two ways: as primary disease vectors,

and as hosts of ectoparasites that transmit diseases.

Diseases

a. Rodent transmitted:

(1) By rat bite:

Haverhill fever—*Streptobacillus moniliformis*.

Rat bite fever—*Spirillum minus*.

(2) By contamination of food and water:

(a) Contamination with urine:

Weil's disease (leptospirosis)—*Leptospira, sp.*

(b) Contamination with feces:

Salmonellosis—*Salmonella spp.*,
Shigella spp.

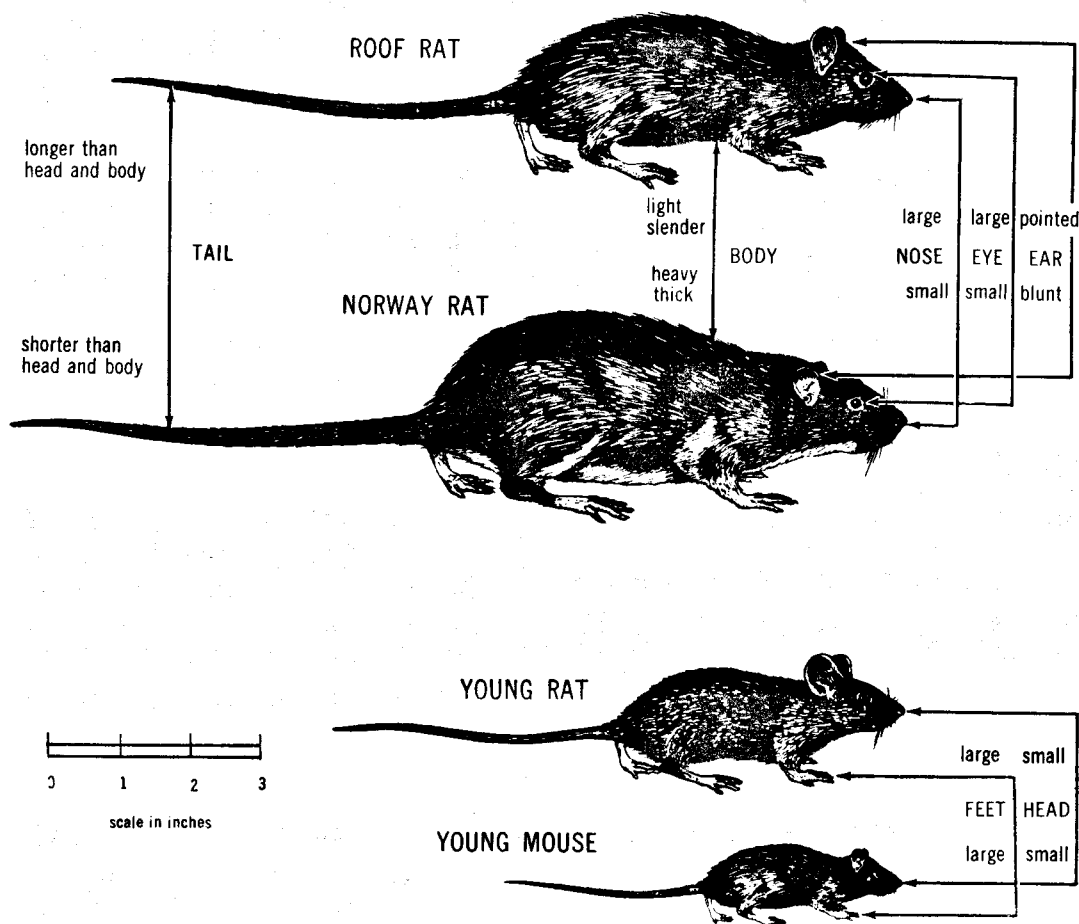


Figure 23-11. Field Identification of Domestic Rodents.

- (3) By inhalation of mouse feces:
Lymphocytic choriomeningitis
- b. Rodent ectoparasite transmitted:
 - (1) By fleas:
Plague.
Endemic (Murine) typhus
 - (2) By mites:
Endemic (Murine) typhus (exp.)
Scrub typhus
Rickettsialpox
Epidemic hemorrhagic fever
 - (3) By ticks:
Tularemia
Rocky Mountain spotted fever
"Q" fever
Relapsing fever
Russian spring-summer encephalitis

Control:

Physical. The most important, and most effective rodent control measures involve denial of harborage food and water. Such measures include ratproofing of buildings and proper storage of foodstuffs.

Destructive. Trapping is a good method of rodent control, but is secondary in effectiveness to poisoning, to which it is often used as a supplement.

Chemical. Anticoagulant compounds are the poisons of choice for rodent control. They are slow acting and have a low degree of toxicity to humans and pets. Three commonly used anticoagulants are fumarin, pival and warfarin. They should be used at a concentration of 0.025% active ingredient by weight in solid baits. Diphacinone is used at a concentration of 0.005% active ingredient by weight, and PMP at 0.05% active ingredient by weight.

Liquid (water) baits may be more effective than solid baits where water is scarce or a variety of foods are available. The sodium salts of warfarin, pival and fumarin are used at a strength of 0.006% acid equivalent and PMP at 0.015%; 5% sugar should be added as an attractant.

Zinc phosphide is used as an alternative poison in solid baits at a rate of 1/5 oz per 1 lb of food. It should be mixed outside and set out in areas protected from moisture.

Note: Sodium monofluoroacetate, "1080," is extremely toxic and should be used only under emergency (plague) situations with the approval of the Surgeon General. (AFM 85-7 reserves approval for use of 1080 to Surgeons General.)

Rodent burrows outdoors may be fumigated with calcium cyanide dust.

Runways should be dusted with a 4 to 5% malathion, 1% lindane, or 2 to 4% chlordane dust before a rodent control campaign is begun in a plague epidemic, so that infected fleas will be destroyed before they leave the dead rats and attack man.

FORMULAS FOR MIXING PESTICIDES

Most pesticides are now received in concentrated form to save shipping bulk and cost. It is therefore necessary to mix most of these chemicals to the desired strength. Two formulas for mixing are given below; others may be found in AFM 85-7.

a. Weight-volume formula:

This formula is used for mixing liquid and dry materials.

Multiply together:

Gallons of spray wanted *times* weight of one gallon of diluent *times* percent of active ingredient wanted.

Divide:

The result of the above multiplication by the percent of active ingredient in the concentrate ("Technical Grade" is usually 100%).

Equals:

Pounds of concentrated pesticide to be added.

Example:

Make 25 gallons of 2% chlordane, using 100% chlordane dust and kerosene (wt 6.6 lbs/gal).

$$\frac{25 \times 6.6 \times 2}{100} = 3.3 \text{ lbs.}$$

b. Weight-weight or volume-volume formula:

This formula is used for mixing dust with dust or liquid with liquid.

Subtract:

Percent of active ingredient desired in final product *from* percent of active ingredient in the concentrate.

Equals:

Parts of diluent to use.

Subtract:

Percent of active ingredient in diluent (usually 0) *from* percent of active ingredient desired in final product.

Equals:

Parts of concentrate to use.

Example:

Make 2% water emulsion of chlordane from 46% emulsifiable chlordane and water.

46% minus 2% = 44 = parts of water to add.

2% minus 0% = 2 = parts of concentrate to use.

44:2 = 22:1.

SAFETY MEASURES

It is the responsibility of the surgeon to supervise and advise on safety precautions to be followed in mixing, handling and applying insecticides and rodenticides.

All pesticides should be considered as poisonous, and should be handled by trained personnel under competent supervision. However, if precautions are observed, and if formulations are accurately prepared and applied, there should be no serious effects to workers or to human and animal populations.

a. Mixing precautions:

All mixing should be done out-of-doors. Personnel should wear protective rubber gloves and old clothing which can be laundered. Clothing that becomes soaked with pesticides or chemicals should be removed at once and laundered before being worn again. (The use of aprons will prevent this condition.) Spillage on the skin should be removed immediately with soap and water. Respirators are needed when dusts, wettable powders, and most liquids are being mixed.

b. Storage precautions:

Installations engineer personnel are responsible for proper storage of pesticides

to protect against fire. The Medical Services should insure protection against personal contamination with pesticides. All containers should be clearly labeled as to their contents, and marked "Poison."

c. Precautions during application of insecticides:

Except when allethrin and pyrethrin alone are being used, respirators should be worn by all personnel engaged in the application of insecticides.

(1) *Dusts.* Dusting operations require the use of the Type C respirator, with dust filter, or Type B-2 respirator.

(2) *Sprays.* Spraying operations require the use of the Type B-2 respirator; the C respirator is NOT acceptable.

Note: The Type C respirator is lighter weight than the B-2, and is much easier to breathe through, and there is a tendency on the part of control personnel to wear the Type C respirator for spray work for these reasons. This substitution is not authorized, since the C filters are not sufficient to stop the passage of spray droplets.

Rubber gloves should be worn when spray equipment is old and in poor condition, and where there is danger of leakage getting on the operator.

d. Precautions in utilization of rodenticides:

The primary precautionary measure to be observed in setting out rat poisons is to place them where there will be a minimum opportunity for humans and other animals to get to them. Placing of bait in places inaccessible to humans and animals, and the use of bait boxes in open areas are recommended.

Zinc phosphide should be mixed out-of-doors on a day when the humidity is low since this poison will release phosgene gas in the presence of moisture.

Calcium cyanide is used in rat burrows outside. No gas mask needed with experienced crews using reasonable care.

e. Fumigation precautions:

Precautions to be observed during fumigation are beyond the scope of this chapter. Some fumigants require special

canisters in gas masks, and some are highly volatile. Refer to AFM 85-7 for details.

Fumigation is not normally recommended for insect control except in special cases, on advice of an entomologist.

REFERENCES

The reader should insure the currency of listed references.

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AFM 161-3, *Rodent Control*.

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