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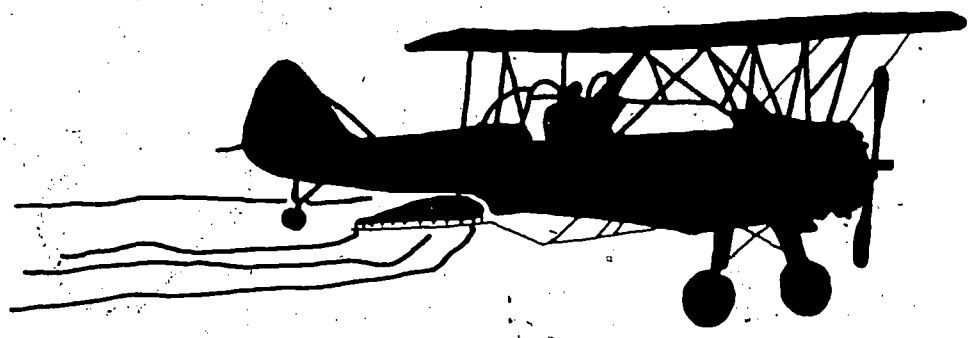
ABSTRACT

This manual is designed to assist pesticide applicators in the category of wood destroying organisms to meet the requirements of the Michigan Department of the Agriculture for certification. The 10 sections included describe: (1) Subterranean termites; (2) Dampwood termites; (3) Drywood termites; (4) Powder-post beetles; (5) Old house borer; (6) Wharf borer; (7) Ambrosia and bark beetles; (8) Carpenter ants; (9) Fungi attacking wood products; and (10) Inspection techniques. A list of self-help questions and instructions for completing the questions are at the end of the manual. (HM)

Control of Wood Destroying Pests



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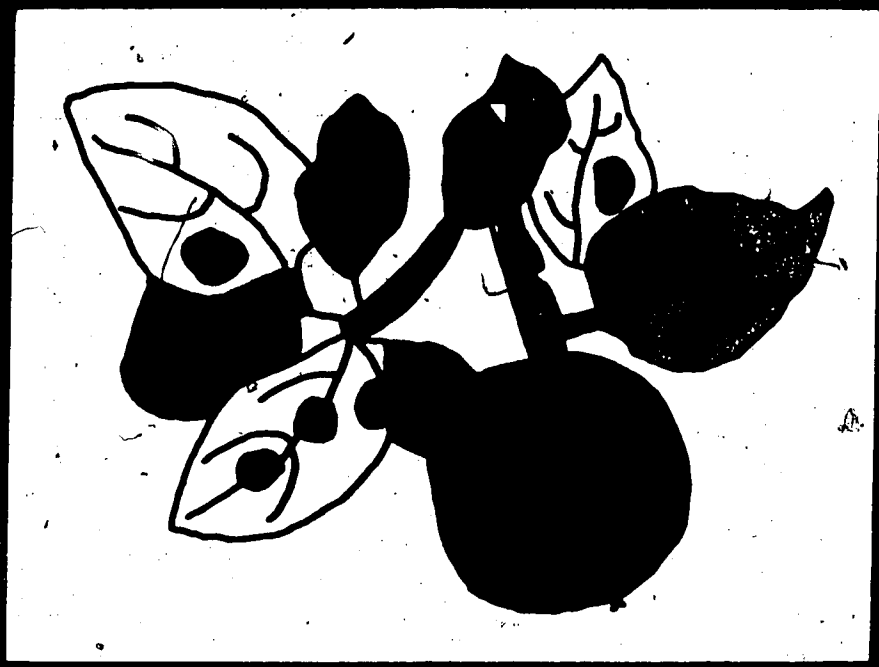
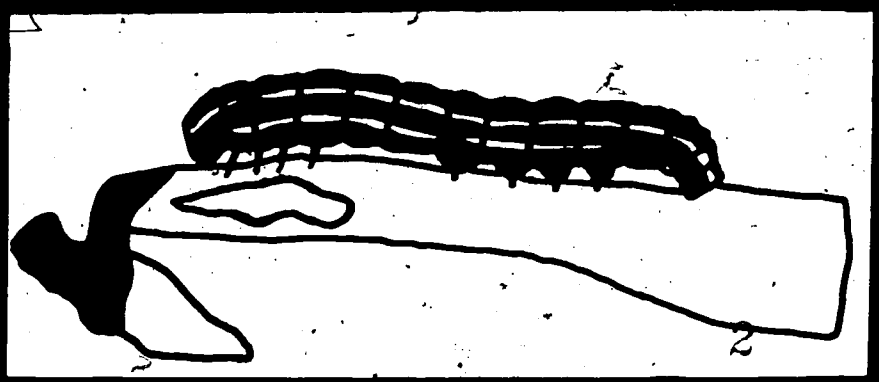
SAFE, EFFECTIVE USE OF PESTICIDES
A MANUAL FOR COMMERCIAL APPLICATORS





PREFACE

This bulletin was prepared to aid pesticide applicators for certification in the category of wood-destroying organisms. The bulletin drew heavily on material from "Industrial, institutional, structural, and health related pest control" by the Department of Agriculture and Commerce of Mississippi and from "Preparing for certification, Volume II, Termites and other wood-destroying organisms" by the National Pest Control Association, and is used with their permission.

A list of self-help questions and instructions for completing the questions are at the end of the bulletin. If you encounter difficulties in using the manual, please consult your county Extension agricultural agent or representative of the Michigan Department of Agriculture for assistance.

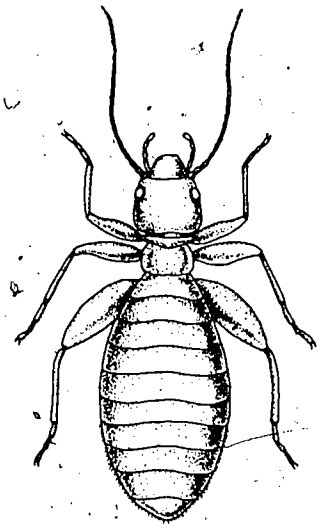
Some suggestions on studying the manual are:

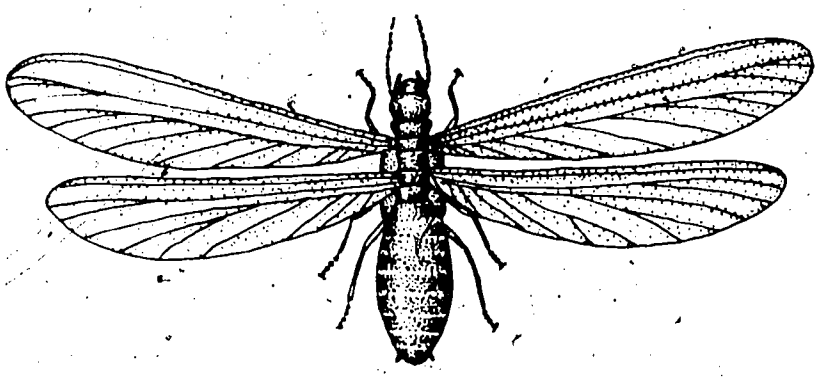
1. Find a place and time for study where you will not be disturbed.
2. Read the entire manual through once to understand the scope and form of presentation of the material.
3. Then study one section of the manual at a time. You may want to underline important points in the manual or take written notes as you study the section.
4. Answer, in writing, the self-help questions at the end of this manual. Instructions on how to use the self-help questions in your study are included with the questions. These questions are intended to aid you in your study and to help you evaluate your knowledge of the subject. As such, they are an important part of your study.
5. Reread the entire manual once again when you have finished studying it all. Review with care any sections that you feel you do not fully understand.

This manual isintended to help you use pesticides effectively and safely when they are needed. We hope that you will review it occasionally to keep the material fresh in your mind.

I N D E X

SUBTERRANEAN TERMITES





Subterranean termites live closely associated with the soil, which is their commonest source of moisture. The termite constructs channels through the soil and tunnels through wood which it eats as food. It really prefers to have its wood food in or in contact with soil. But it also will construct tunnels or tubes from the soil to wood to get food, and this it often does to get at the wood in houses—constructing

tubes through cracks in slabs, through expansion joints, inside masonry walls or in the voids in concrete blocks, across the face of foundations, or in any crack in the foundation or between foundation parts. Termites also will build tubes back from the wood of a house to the soil if their normal avenue of travel is cut off or becomes undesirable.

Life Cycle

The forms of termites that are usually seen are swarmers, winged termites, or alates. These swarmers are the young males and females that are sent out from established parent colonies to found new colonies. They have not paired off or mated when they come out of the parent colony. They only do this after they are out in the world—usually after they have taken flight.

They are not strong fliers. Their wings are fairly large in their bodies, however, and their bodies are not heavy, so their fluttering flight can carry them considerable distances. They are light enough so that they will travel on drafts of winds almost the same as fly-ash. Thus an updraft into wind will carry them some distance.

The life of the swarmers is very precarious when they emerge from their colony. All sorts of hazards await them: Ants are mortal enemies of termites and prey on them, and birds also feed on swarmer termites.

The colony is particular about the conditions under which they send these swarmers out. The temperature, moisture of the colony, moisture of the outside or rainfall or humidity, light conditions, and even barometric pressure combine to determine if the swarmers that have developed in a colony will be sent out on their flight. It is these swarmings that most frequently bring the presence of termites to the attention of a homeowner.

Termites do not confine their attack to houses. Their natural habitat is in forests where they have been the scavengers of dead wood for centuries. Only when man started to build houses in their natural environment did termites start feeding on the houses—and then only after they ran out of readily available dead trees.

Many colonies of termites swarm each year or every other year and do not attack houses. You are as apt to see a swarm from a tree stump or from a partially deadtree as you are from a house.

Swarmer termites are often confused with flying or swarmer ants. These winged ants also emerge from their colonies each year just as the termite swarmers do. People often get as excited about an ant swarm as about a termite swarm, and it is important to know the difference between the two.

There are three things that you can see very easily that will help you tell the difference.

1. The first is the shape of the body:
   - The ant has a narrow or a wasp-waist.
   - The termite is straight down the sides.
2. The wings of the ant are also very different from those of the termite.
   - The termite's wings, and there are four of them—one pair forward and one pair rear—are elongated paddle-shaped. The front ones are about the same length as the rear ones—generally the same shape. They are translucent—you can't see through them, but almost. They have many fine veins in them, but there are no dark spots on the. They are evenly colored.
   - The ant's wings are different; they have only a few veins in them and there is one little area at the front edge of the front wing that is distinctly darkened into a spot. Also the front wing is larger, longer, and of a different shape than the rear wing.
3. A third difference is in the shape of the antennae.
   - The termite's antennae look like a string of a little beads. There is no sharp elbow in them.
   - The ant's antennae are made up of a long base segment which makes an elbow with the rest of the segments.

After swarming from the colony the male and female termites pair off. The female sort of stops and raises her abdomen in an upward curve. When a male finds her, he falls in step behind and seeks a suitable habitat for mating. This is called traveling in tandem. If the first male falls by the wayside the female stops until another male notices her, and again they go off in tandem.

They seek out some place which offers a good combination of shelter, food and moisture. When a suitable spot is found, they enlarge a cell in either the soil or the wood, enter the cell, seal it up, and copulate, or mate—often within a few hours but sometimes it may be weeks later.

The female can retain sperm for egg production for approximately six months and then she needs to be refertilized. The male who now is a "king" lives with the female, the "queen," through life. The female lay eggs and they hatch in approximately 50 days (30 to 80 days is the range) into little nymphs.

In our native subterraneans the first batch of eggs is not large, probably not over 20. The king and queen care for the eggs and the young nymphs, and feed them through their first two instars, or molts; then at the third instar they become self-supporting and assume the duties of caring for and feeding younger nymphs and the king and queen.

At the third instar the nymphs start to separate into different kinds of nymphs that can develop into the different castes that exist in a fully developed colony. These castes are: workers, soldiers, and reproductive forms. There are three different reproductive forms: (1) queen and king; (2) winged forms that are sent out to spread the species by establishing new colonies; and (3) supplemental reproductives which are males and females developed within the colony.

As nymphs develop they may be without wings (normally will grow into workers), with wing buds or wing pads (normally will grow into winged reproductives), or with enlarged and hardened head (normally will grow into soldiers). The workers do the work assisted by the nymphs, the soldiers guard the colony, and the winged reproductives spread the species. The supplemental reproductives become capable of doing the duty of either a queen or king if the occasion where one is needed arises. Examples are when the queen dies, when the colony is fractured, or when the colony has grown large.

Feeding

Termites need: (1) food, which they get from wood or other cellulose material; (2) a medium through which to build their workings; this can be soil or wood or other cellulosic material; (3) water which they normally

get from soil but accept from any other source. Colonies can exist cut off from soil on water from roof leaks or condensation. Such colonies may swarm or may establish supplemental reproductives and continue activity if a water resource is maintained.

The workings of the termites are kept sealed except for emergence of swarms. When broken, they are resealed quickly.

Subterranean Termite Control

The basic principle of termite control is to prevent access to food (wood) and moisture by the termites. The five ways of preventing access are: mechanical, alteration, soil treating, foundation treating, and wood treating.

Mechanical:

- Separate structural wood members from direct contact with soil.
- Block the termite's avenues of access to the structure by chemical treatment of the soil, the foundation areas, or the wood itself.

Alterations:

- Clean up—get debris out from under or beside the building, clean up storage areas, and clean up around construction.
- Moisture correction ranges from repair of drainage downspouts or siding to the fixing of a leaky garden hose outlet. Stopped up storm drains are not within the area of the PCO, but should be a part of the advice given.
- Ventilation to prevent accumulation of moisture is enclosed areas such as crawl spaces. Recommendations for small buildings are 2 square feet for each 25 feet of perimeter, for larger buildings 1/2 square foot for each 25 feet of perimeter plus 1/2 percent of area enclosed by perimeter.
- Breaking wood contact with soil. Examples of places where contact occurs: (1) siding under grade or window frames: (2) clearance under sills; (3) posts, wood steps, lattices, curtain walls, ornamental fences, or attachments for fences or gates in contact with soil;

- (4) outside stairs and fire escapes; (5) all sorts of wood paneling attached to basement walls: (6) partition walls in basements; (7) grade stakes may even provide a passageway.

Soil treating: Soil treating establishes a chemical barrier between the workings of the termites in the soil (where there is moisture) and the structure to be protected.

Chemical barriers should be made:

- along outside of foundation,
- along inside of foundation,
- under slabs, or
- around utility entrances.

Means of soil treatment are:

- pouring,
- trenching,
- trenching and rodding vertically,
- rodding horizontally, and
- drilling down and flooding.

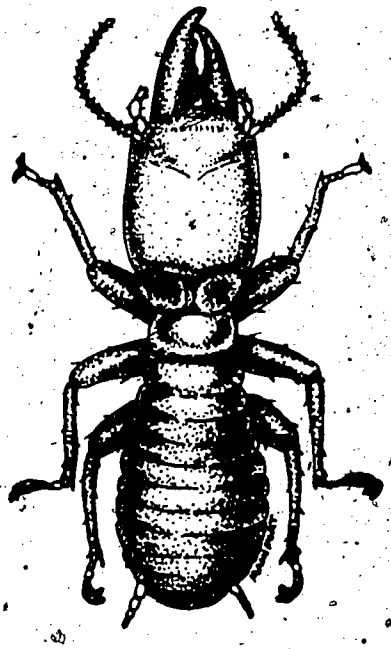
Foundation treating: Keep treatment as low as possible as chemicals applied higher up are wasted. The purpose of foundation treating is to get chemicals into any cracks at the footing.

Wood treating: This is usually a supplemental step to chemical treating alteration. Termites will tube over treated wood. Infested wood is often drilled and flushed with soil toxicants to quickly eliminate termites above ground and reduce the likelihood of posttreatment swarms. All wood in direct contact with the soil should be pressure treated or, if left in place, treated with a creep emulsion or gel of pentachloraphenol. Wood treating is also a useful supplement when soil treatment must be limited, as when a well is close by.

DAMPWOOD TERMITES

Dampwood termites have a biology similar to that of subterranean termites. Their colonies tend to be smaller, however, and a major difference between the two is that dampwoods seldom live in the soil. They nest in damp wood—and are usually associated with wood decay. They do not construct tubing. Small openings are made between the galleries and the wood surface. Six-sided fecal pellets are discarded from the galleries through these openings. Dampwood termites are not native to Michigan.

Control consists primarily of correct the moisture condition. The damaged wood often requires replacement. Pressure-treated wood should be used if the moisture condition will continue. If the wood is not to be replaced, the galleries should be drilled and flushed with an insecticide to eliminate the infestation.



DRYWOOD TERMITES

The various species of drywood termites have workers, soldiers, reproductives, and swarmers in colonies. Unlike subterraneans and dampwoods, drywood termites live and feed on sound, dry, seasons wood. They have no soil connection and need no moisture source. The colonies are small and pellets are produced similar to those of dampwoods—but smaller.

Drywood termites are not native to Michigan, but may be brought up on lumber or furniture. Control consists of eliminating the colony. In minor infestations, this can be accomplished by removing the infested wood or by drilling it and injecting chemicals into the galleries. In many cases, however, fumigation of the structure with methylbromide or sulfuryl fluoride (Vikane) is the only practical and effective control method. Blowing a desiccant dust such as a silicagel into attic spaces may reduce the probability of reinfestation.

POWDER-POST BEETLES

Among the many different kinds of insects that attack wood and wood products, the destructiveness of lyctid beetles is rated second only to that of termites. Their activity causes many millions of dollars worth of damage in the United States each year.

Lyctids are a pest primarily of the sapwood of hardwoods and are more commonly found in recently dried rather than old wood. They are found infesting hardwood flooring, hardwood timbers, plywood, crating, furniture, tool handles, gun stocks, and many other specialized wood articles. Their attack is characterized by the reduction of sound wood to fine powder.

Distinguishing Lyctids From Other Wood-Boring Beetles

Beetles that as larvae feed in seasoned wood and thereby produce finely divided frass (undigested wood and excrement) are known by the general common name powder-post beetles. Included in this name are insects of many different biologies and insects with a wide range of damage potential.

Among the beetles that attack seasoned wood, the cerambycids, oedermerids, and buprestids are not often confused with the others because of their greater size. The adults of these three groups of beetles are often brightly colored and may vary in length from 1/4 to 3 inches. The larva reach a length of 1/2 to 3 or even 4 inches.

Curculionids have the head prolonged into a typical weevil snout or beak. The only important wood borers among the weevils are the cossonids.

We should, however, look more closely at the differentiation of the bostrichids, anobiids, and lyctids.

Bostrichidae: The bostrichid powder-post beetles vary from 1/8 to 1 inch in length. They are usually dark brown to black in color and have a cylindrical shape. On most (but not all) bostrichids the thorax is

noticeably roughened and forms a hood which obscures the head when viewed from above.

Anobidiidae: Anobiid powder-post beetles are reddish brown to dark brown and covered with fine yellow hairs. They can be 1/10 to 1/5 inch in length. Like the bostrichids, they are rather cylindrical in shape and the thorax hides the downward-directed head when viewed from above.

Lyctidae: Lyctid powder-post beetles are 1/8 to 1/5 inch in length and vary from reddish brown or chestnut to black. They are somewhat flattened and the head is distinctly visible from the top.

Factors Affecting Lyctid Attack

The major factors that influence the attack and subsequent development of lyctid beetles are:

1. moisture content of the wood,
2. starch content of the wood, and
3. pore size of the wood.

Moisture content: On the average, seasoned lumber in the United States has a moisture content of from 12 to 15 percent.

Lyctids seem to be most active in wood with a moisture content of from 10 to 20 percent although the actual limits of infestation are wider. Noticeable activity is not found in wood with a moisture content above 32 percent. Nor do they readily establish themselves in wood that has less than 8 percent moisture. Thus, it can be seen that the attack of Lyctidae is generally confined to partially seasoned or wholly seasoned wood.

Starch content: For nourishment the lyctids rely mainly on the sugar and starch content of the cells. This stored food material is only present in the sapwood portion of the tree. Hence, only this sapwood is susceptible to attack, the higher the starch content, the more susceptible. The female lyctid will not deposit eggs in sapwood with a starch content lower than approximately 3 percent.

Lyctid larva are not able to digest the cellulose and hemicellulose which form the cell walls and make up the bulk of the woody tissue. These substances pass through the digestive tract of the larva virtually untouched and account for the large amounts of powdery frass left by the beetles.

In kiln drying, freshly cut lumber is heated in large kilns to speed seasoning. If low kiln schedules are used with temperatures below 100°F., starch depletion is speeded up, leaving the lumber relatively starch free and, therefore, less susceptible to lyctid attack. However, if the higher kiln schedules are used (temperatures over 115° F.), and rapid drying is induced, the starch will be retained at a high level and the wood will be more susceptible to the beetles.

Pore size: Another important factor influencing lyctid attacks is the size of the pores in the wood. The female beetles place their eggs into the exposed pores in the ends or along the sides of the wood. If the lyctid can insert its ovipositor in a pore, eggs can be deposited there. As a general rule, then, only those timbers with pores as large or larger than the size of the ovipositor are attacked.

Woods with very large pores are the ones most often infested. These include ash, elm, oak, pecan and walnut. Woods with smaller pores such as birch, maple, sycamore and willow are attacked but not nearly as heavily. Very fine pored woods such as apple, beech, and magnolia are relatively immune to lyctid infestation.

Softwoods are considered generally immune to lyctid attack because they do not have pores and usually have a low starch content. There are records, however, of lyctid beetles infesting and even completing development in softwoods. In these cases, the eggs probably were deposited in the open resin ducts of soft wood with sufficient starch to permit larval development.

Bamboo, which is attacked by some lyctids, is technically classified as a grass, but meets the requirements necessary for lyctid attack.

In review, then, remember that under normal circumstances, lyctids will attack:

- Wood with a moisture content of from 8 to 32 percent but preferably in the 10 to 20 percent range.
- Sapwood with a high starch content—at least 3 percent.
- Larger-pored hardwoods.

Life Cycle of Lyctid Beetles

Lyctid beetles exhibit complete metamorphosis, that is, they develop in four distinct stages: egg, larva, pupa, and adult. The female lays her eggs in the open pores of the wood, the eggs hatch, and the larvae tunnel through the wood reducing it to powder. After a period the larva forms a cavity near the surface of the wood and pupation occurs. When the adult emerges from the pupal stage it cuts its way to the surface leaving small round holes where they emerge (flight hole). The adults mate soon after emergency, fly readily and usually hide during the day. A complete life cycle in three months is possible but most powder-post beetles require a year.

Identification of Lyctid Damage

Lyctid attack is characterized by the presence of large amounts of extremely fine, flourlike powder falling from the flight holes, larval holes and cracks on the undersurfaces, and dust piled around the flight holes, larval holes and working out of the cracks on the top surfaces. The frass left by other wood borers almost always contains pellets, has a coarse nature or a tendency to stick together. This quality can readily be determined by examining the frass under a hand lens to see if pellets or lumps are present.

When inspecting beetle-damaged wood be sure to distinguish old damage from active beetle infestations. Remember that powder may continue to show up long after the beetles have been eliminated from the wood. Vibrations or jarring will force the frass through cracks and old flight holes in floors, paneling, furniture, etc.

Don't be confused by dust made by friction of two pieces of wood as by the opening and closing of drawers in furniture.

Occasionally old flight holes are plugged with sawdust or a filler when wood is milled or refinished. In time, these plugs will loosen and fall out, exposing the hole. Do not mistake this old damage for an active beetle infestation. Newly formed flight holes are light and clean in appearance; older ones are darker in color. This color change is also evident in the frass left by the lyctids.

Prevention of Lyctid Attack

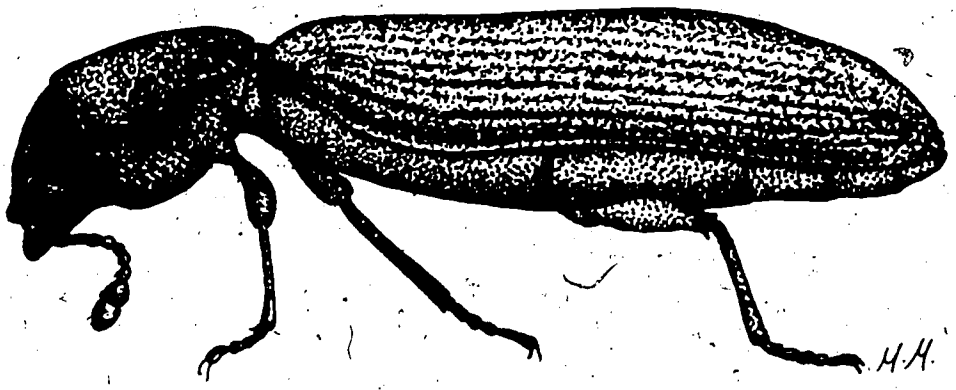
Flooring, furniture, tool handles and other articles newly made from hardwood are very susceptible to attack by lyctids. Managers of mills, lumberyards, warehouses, building lots and similar places where hardwood items are stored, must maintain a vigorous program for the prevention of lyctid infestation. PCOs can provide useful service to such businesses in giving advice, making inspections and treating to prevent or eliminate infestations. Without an effectiye preventive program, lumberyards, builders' lots and the like may become the source for infestations which do not appear until months after flooring, paneling, furniture or tools have been put to use. Good storage practices are necessary to prevent lyctids from becoming established in susceptible wood products in buildings and lots of this type. An effective preventive program consists of:

1. Sanitation: Piles of hardwood debris, dead branches, old lumber and other possible food materials should not be allowed to accumulate in the storage areas.
2. Stock rotation: Items in storage the longest should be used first.
3. Inspection: Storage areas should be inspected periodically. Infested stock should be removed or treated to prevent spread of the infestation.
4. Destruction: Infested items, if salvable, can be treated. Otherwise, they should be destroyed by burning.
5. Protection: Items used in storage such as pallets, stacking sticks stakes, platforms, shelves, etc., should be protected against attack. Also, it may be desirable to protect the stored products themselves. These protective measures are of two types: physical and chemical.

a. Physical prevention—Raw wood products can be protected before attack by applying any substance that closes the pores of the wood. For example, paraffin wax, varnish, shellac, and paint all deter lyctid attack by preventing the beetles from laying their eggs.

b. Chemical prevention—Lumber and wood products can be effectively protected against lyctid attack by submerging them in a cold water emulsion or an oil solution of an insecticide registered for such use.

ANOBIID POWDER-POST BEETLES



Anobiid infestations may be encountered with inspecting crawlspaces and basements for wood-destroying insects or when a customer finds cabinets, furniture, or woodwork infested. Anobiid infestations are characterized by small holes in wood surfaces with fine to coarse powder sifting from them. Other wood borers produce signs of infestation that might be confused with signs of anobiids.

Identifying Anobiid Infestations

Anobiids infest all types of seasoned wood—sapwood and heartwood of both soft and hardwoods. Infested wood has many round, small (1/32 to 1/8 inch) holes on the surface. The frass which sifts from the holes is a fine to coarse powder and contains small blunt-ended pellets.

Other beetles which produce small holes in wood surfaces are lyctids, bostrichids, and scolytids. You can distinguish anobiid damage from that produced by other beetles as follows:

1. Lyctids make only small holes (1/32 to 1/16 inch) and the frass is very fine, resembling talcom powder. Anobiids produce coarser frass which contains pellets and which feels hard and gritty when rubbed lightly between the fingers.
2. Most bostrichids make larger holes (more than 1/8 inch) which do not contain frass. The tunnels within the wood do contain frass, but it tends to stick together (cakes).
3. Scolytids (ambrosia beetles) make holes about 1/32 to 1/8 inch in diameter, but the holes do not contain frass and the surrounding wood usually has a blue-black stain.

Determining the Age of an Infestation of Anobiids and Whether or not it is Active

You can often determine if an infestation is well established by the presence of: (1) more than 30 exit holes/sq. ft. of surface of infested wood, and/or (2) small pin-sized exit holes in the wood made by wasp parasites of anobiids.

Many anobiid infestations in seasoned wood apparently die out without treatment. Frass may continue to sift from the holes for many years afterwards. You should not treat inactive infestations. An infestation is active if you:

1. examine 100 holes at random and find evidence of some being freshly cut (example: they are as light as a fresh saw cut); or
2. examine the frass and find it is not yellow-looking or caked; or
3. place black asphalt felt or other dark material beneath infested wood for one year and frass piles accumulate on the felt (small amounts may sift out from normal vibrations of the wood).

Recognition and Habith of Anobiids

A number of anobiids infest seasoned wood in the United States. The adults range from 1/10 to 1/3 inches in length and are red-brown to almost black. The head is characteristically bent downward and is hidden by the pronotum (the section of the back between the head and the wing covers) so that it cannot be seen from above.

During early evening hours, the adults fly and are most active. It is also during these hours that the tapping of the death watch beetle is heard. The sound is made by the adult striking its head against wood and is a mating call. Not all anobiids make this sound.

Most adults emerge from April through July, but emergence may continue into September in the South. The adults live several weeks or more, during which they mate and lay eggs. When inactive, the adults rest on the wood surface or in exit holes.

A female anobiid lays up to 100 eggs, depositing them indivdually on the wood surface, into cracks or crevices in the wood, or occasionally in the mouth of an old exit hole. Most of the eggs are laid during the first three weeks of a female's adult life. The eggs hatch in one to two weeks. The relative humidity must be 45 percent or higher for hatching—indicating that correcting moisture conditions may aid in control.

Upon hatching, the young larvae bore immediately into the wood. The larvae spend their entire life feeding and tunneling through the wood. They usually mature within one year, but some evidence suggests that if the wood continues to dry out and has less than 15 percent moisture, the larval stage may last for two or three years.

The larvae pupate within the wood, with the pupal stage lasting two or three weeks.

OLD HOUSE BORER

In the United States, *Hylotrupes bajulus* has the official common name old house borer. The insect is an increasingly important destroyer of building framing and other objects made of the sapwood or softwoods.

The name, old house borer, gives the impression that the insect is primarily a pest in old buildings. While it may attack ancient structures and a building may be many years old before attack is discovered, the "old house borer" most often attacks new structures. This is particularly true in the United States. Since the old house borer has a very long life cycle and can infest the same piece of wood again and again, it may be several decades before serious structural damage is recognized.

Distribution, Importance and Spread

In the United States, the old house borer has become well established in most of the states along the Atlantic Coast. Infestations seem to occur most frequently in Maryland, Virginia and North Carolina. One or more infestations have been reported from many other states as far west as Louisiana and Minnesota.

Once the beetle has become established in a favorable area, it seems to spread both by movement of infested lumber and by direct movement of the adults from house to house.

Description

Adult old house borers are greyish-brown to jet black hard-shelled beetles. Females are bigger than the males. The larger females may be nearly an inch long while the smaller males may be only 3/8 of an inch in length. When newly emerged, the beetles have a rather greyish appearance because of the dense covering of light-colored hairs. These hairs, which

are fairly long on the forward part of the body, tend to wear away and disappear when the beetles are old or have been wet with oil or water.

On the pronotum there are two black, shiny bumps. When these bumps are surrounded by the long grey hairs, the result is an owllike appearance.

Life History and Habits

The preferred site for egg laying seems to be a joint between two pieces of wood, a narrow crack, or a checkmark that develops in shrinkage of wood during drying. Stacked piles of susceptible lumber provide many excellent oviposition sites. If such a place is found, the female may begin laying eggs at once, but she can wait several days to do so. Eggs are deposited singly or in small clusters. Usually 150 to 200 eggs are laid, but over 500 may be laid by a single female. The egg stage lasts only a few weeks, tending to be shorter at higher temperatures and humidities.

The young larvae bore into the wood adjacent to where they hatch their eggs. They prefer to tunnel across the grain of spring wood. The young larvae are so small that their presence is seldom seen or recognized. As the larvae become larger they tend to work along the grain. The larvae almost never break the surface of the wood with their tunnels.

The feeding period may be as short as one year if the larva has an ample supply of wood rich in food value which is in a warm, moist place. In structures the larva usually feed for several years before becoming fully grown and ready to pupate. The pupal period lasts only two or three weeks and usually occurs in the spring. Constant temperature is not favorable. Some period or periods of low temperature are needed for pupation. Even a few days at or below freezingare not so favorable as the prolonged cold of a winter.

Emergence of the adult occurs during warm weather, ordinarily in late spring or summer. They are said to be strong fliers. The adults do little, if any, feeding but are capable of chewing or biting exit holes through hardwood, plaster and other hard materials.

The complete life cycle may be as short as one year and as long as 32 years, but 3 to 10 years is the typical range.

WHARF BORER

Wharf borers, *Nacerda melanura*, are about the size of a German roach, have black wing tips, and resemble long-horned beetles. They emerge in late spring or early summer and are nuisances in buildings. The larvae feed on decaying wood. This insect is most common along our coast lines and major inland waterways.

Description

The adult is 1/4 to 1/2 inch long, soft-bodied, with leathery wing covers. The upperside is yellow to red-brown with fine golden hairs. The hairs are often worn off on old specimens. The identifying characteristic of this beetle is the black tip of the wing cover. The beetles underside and legs are black to brown. The antennae are half as long as the body.

Distribution

The wharf borer appears frequently along the Atlantic and Pacific coast and near the Great Lakes. NPCA records indicate it is most common from New England to North Carolina and westward to Minnesota. It has caused serious damage or annoyance in many other areas including: San Francisco Bay; San Diego; Houston; Charleston, South Carolina; and Fargo, North Dakota.

The wharf borer is said to have originated in Europe but has been spread throughout the world by shipping.

Life History

Little is known about the wharf borer's life history. The eggs apparently are laid in or on softwoods or hardwoods that are damp to soggy. Infested wood is usually decayed but the relationship between decay and wharf borer

infestations is unknown. The larvae make tunnels in the wood and eventually pupate there.

Apparently there is one generation per year. Some larvae, which appeared to be only a few weeks old, were maintained all winter in a laboratory at room temperature and high humidity. They pupated in the spring; the pupal stage lasted seven to nine days and the adults lived one to two weeks.

Adults emerge in large numbers about the same time each year. Emergence usually occurs from April through July.

Habits and Economic Importance

Waterfront structures—especially in the "splash zone" along tidal streams—may sustain serious damage. Untreated southern pine extending above water and used as a baffle in an underground reservoir was heavily infested.

Infestation occurs in nonwaterfront areas such as pilings under buildings in swampy situations; where water from drains, irrigation tanks or leaky pipes keeps wood wetted yet not constantly submerged; and in wood lying on damp ground, especially in crawl spaces.

In many areas wharf borer problems are associated with redevelopment activity. When old buildings are torn down to be replaced by new modern structures, or parking lots, it often happens that heavy timbers and similar debris are buried deeply in the soil. If this wood is at or near the water table, an ideal situation for wharf borer breeding exists since breeding activity apparently is most prevalent a few feet above the permanent water table. There is some evidence that the situation is even more favorable for wharf borers if the wood is wet by brackish water.

Where the wood is buried, the adults apparently mate and lay eggs before emerging from the soil. In the Boston area, it has been observed that there is likely to be a peak in emergence three years after demolition of buildings.

The chief objection to wharf borers is the nuisance they create when they emerge. Many thousands of adults may appear suddenly in a new or old structure, after emerging from wood within the structure or in the soil around it. They tend to move to windows, doors, and other sources of light.

The beetles crawl on persons as well as objects. Their sudden appearance may suggest termites to some people, while others confuse them with cockroaches.

The adults do no damage. They emerge during the day and are attracted to natural light, and they are reported to feed on flower pollen.

Whether wharf borer larvae actually damage wood is a debatable point. In most cases, the wood on which they feed is already decayed.

AMBROSIA BEETLES AND BARK BEETLES

Ambrosia beetles and bark beetles are wood-infesting insects that damage only trees and green wood. The damage remains in the wood after it is cut, but it does not increase because the insects that cause it are unable to live in dry wood. Framing, trim or flooring of new or nearly new homes often show evidence of past attack by one or both of these beetles. No control measures are required, but such damage needs to be distinguished from that caused by other wood-destroying insects which do live in and damage wood in structures.

Ambrosia Beetles

Ambrosia beetles are tiny to small in size, reddish brown to nearly black in color, and have cylindrical, hard-shelled bodies. The group includes two families, the Scolytidae and Platypodidae. Most of the scolytids are stubby and less than 1/8 inch long, while the platypids are slender and about 3/8 inch long.

Ambrosia beetles are so named because their larvae feed only on ambrosia fungus which grows in moist, usually green, wood. The beetles introduce the fungus spores into the tunnels they excavate in wood, and it is said that each species of ambrosia beetle has its own special species of fungus. Wherever the fungus grows, the wood is stained blue, black or dark brown. Ambrosia beetles' attack on seasoned wood is very rare, but it sometimes occurs in wood such as wine casks or water tanks that are constantly wet.

Ambrosia beetle damaged wood can be recognized by the dark stains in the tunnels which spread to adjoining wood. Also, the tunnels are open because there must be spaced for the gungus to grow and for the beetles to move around.

In wood in a building, damage from ambrosia beetles may be found in either softwoods or hardwoods. In the latter case, it is sometimes confused with damage due to powder-post beetles. Since powder-post beetles can infest and reinfest dry hardwoods and ambrosia beetles cannot, it is important to distinguish between the damage produced by these two groups. Ambrosia beetle holes are empty, darkly stained and intercept milled surfaces at various angles because their damage was done before the wood was sawed. Occasionally, such holes are filled with wood fillers, by dust from sanding operations or by dust from rubbing drawers. If it is ambrosia beetle damage, careful inspection will show the characteristic staining. Powder-post beetle holes are normally filled with fine wood-colored dust, are unstained and those from active infestations pierce the wood at right angles to the surface.

If live ambrosia beetles are found indoors, the most likely source is firewood which has recently been cut. Since their attack ends before or shortly after wood is brought indoors, no control is needed.

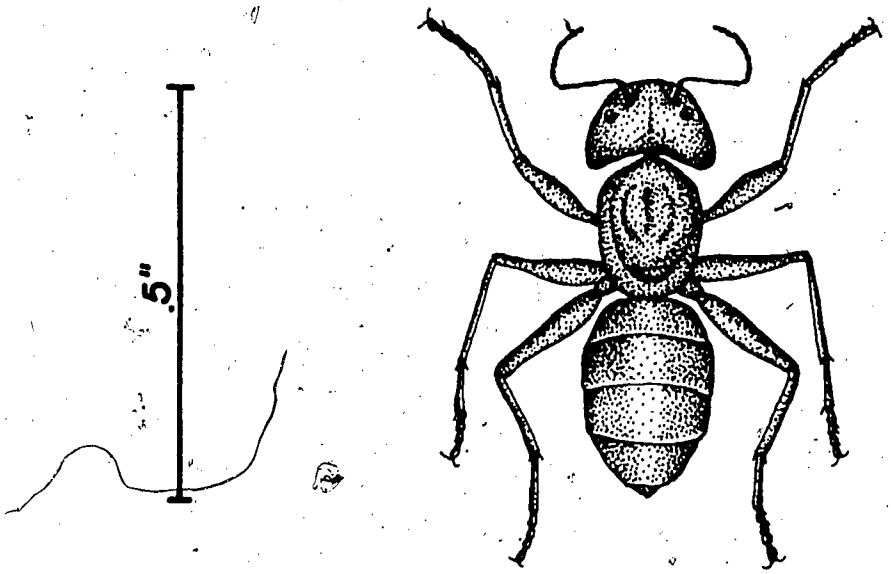
Bark Beetles

Bark beetles tunnel through the bark and often score the surface of wood, giving rise to the term "engraver beetles." The brownish frass made by their borings in bark and sometimes the beetles themselves come into houses with firewood or under the bark on lumber.

In the woods the adult beetles bore through the bark of weakened or recently cut trees. They work along the wood surface, leaving a tunnel in which their eggs are laid. The larvae hatch from the eggs and feed out laterally but remain between the wood and the rough bark. Each species creates a characteristic pattern of engraving. Bark beetles loosen the bark from the wood and do not penetrate deeply if at all into the true wood. Consequently, evidence of their attack occurs only on the surface of wood that is, or has been, covered by bark. The frass they leave is the same color as the underbark, generally a reddish brown color. It falls from loose bark as small granular particles which feel gritty like fine sand rather than smooth like a powder.

Bark beetles are often found in buildings under unfavorable conditions. They may require two or three years to emerge. This is an important observation, for householders often are needlessly concerned by emergence of bark beetles a year or more after their home is built. The beetles are often found at windows where they are attracted by light. Although the emerged bark beetles may be a nuisance for a short time, they cannot reinfest the dried bark, and they cause no loss of strength to the wood from which they came. Their nuisance value can be reduced by pulling off accessible bark and removing frass with a vacuum cleaner. Sometimes the fall of frass from hidden areas can be stopped by placing tape over cracks in floor boards, etc.

CARPENTER ANTS



Carpenter ants are frequently found emerging from wooden structures. These pests work wood much like drywood termites. Old drywood termite nests are frequently occupied by a number of species of carpenter ants. Carpenter ants are meticulous; they clear everything from the galleries. Thin and unwanted partitions are removed, but the gallery is not enlarged to any great extent. Their cleaning activities create distinct piles of different kinds of pellets, chips of wood, and other debris. Such piles are placed in locations near the nest and are diagnostic of carpenter ant infestations.

The workers are found at night roaming around various areas searching for sweets of one kind or another. These pests do not eat wood. The workers are large, long legged and black to brown in coloration (or some combination of the two colors). Worker adults of several sizes may occur in one colony. Usually, one must find the piles of frass in order to locate the small doorways through which they travel. If there are too many ants and all their locations cannot be found, fumigation might become necessary.

FUNGI ATTACKING WOOD PRODUCTS

Wood decay is caused by minute plants called fungi. These plants consist of microscopic threads that are visible to the naked eye only when many of them occur together. The fruiting bodies (deadwood conks, mushrooms) of fungi from which their spores are distributed are easy to see. Some fungi merely discolor wood, but decay fungi destroy the fiber. Decayed wood is often dry in the final stages, but not while the decay is taking place since these fungi require considerable moisture. Therefore, there is no such thing as "dry rot," and decay is a minor problem in the driest parts of the country.

Spores or "seeds" of decay fungi are always present in the air; they can't be kept away from wood. But fungi can grow in wood only when it contains more than 20 percent moisture. Air-dry wood is regularly below this danger point. One should particularly avoid infested lumber that is wet. It is especially dangerous where the lumber is so enclosed that it cannot dry. Wood infested heavily by stain fungi should also be avoided since it often contains decay fungi as well.

INSPECTION TECHNIQUES

Equipment

A good light is essential and most inspectors prefer the five-cell flashlight. Extra batteries and bulbs for the light may often prevent unnecessary delays. A heavy jackknife; an ice pick or a small wood chisel for probing into the wood is also a necessity. A thick piece of spring steel or a hacksaw blade is needed for testing earthfills. A screwdriver, measuring tape and hammer should be included with the equipment. A light, strong six foot stepladder is essential. Coveralls, a stocking cap, gloves and sponge-rubber kneepads make up the balance of the essential equipment. Persons subject to dust irritation should also include a small compact respirator.

Some inspectors carry cameras with flash attachments to photograph special conditions. A sizeable clipboard equipped with cross-section paper is handy to sketch a diagram of the structure and make notes of findings. Finally, a whisk broom, some waterless soap and a supply of clean rags are additions to include with the equipment.

Procedure

Examination procedure will be divided into four parts: (1) the exterior, (2) the interior, (3) the attic and (4) the substructural area. Before proceeding with the inspection, the inspector should explain his mission to the occupant. A few questions concerning his or her observations regarding insect occurrence, damage, plumbing leaks, or other irregularities, may be very helpful.

Exterior examination: Walk slowly around the structure pacing off the approximate measurements and draw a rough diagram. By using "engineering" cross-section paper, which is laid out on the decimal system, the inspector will find it easier when totaling the lineal feet. Set in the porches, patios, vents, vent-wells, columns and pilasters. Also record the moist areas, exterior grade conditions, vertical foundation cracks and exterior grade conditions, vertical foundation cracks and exterior earth-to-wood contacts. If the structure is stucco finished, tap the stucco below the top of the foundation with a heavy pocket knife, hammer or some object heavy enough to produce a hollow sound if the basal stucco is loose.

This phase of the inspection is very important whether the structure is on a slab or is a crawl-space type. Many of the earlier concrete slab-type houses have an exterior plumbing vent or hatch which should be removed and the inside checked. Many of the older stucco finished structures were decorated with columns, pilaster and arches as well as buttress-walls; these were not always provided with a proper footing and should be checked. If the footing conditions are doubtful, it may be necessary to recommend opening and would thus necessitate an additional inspection with supplemental report. Note shrinkage cracks between the foundation and such attachments as concrete porches, patios, vent-wells, masonry or concrete planters, stone facings, and masonry chimneys.

The size and condition of substructural ventilators is a must in the case of F.H.A. inspections or where Uniform Building Code requirements are present. The condition of the crawl-vents is of primary importance if small children or animals are to be kept out of the subarea. If the vent-frames are of wood, note deterioration or exterior earth contact. Where shrubbery is dense adjacent to the structure, ventilators may be partially or completely blocked.

Don't forget to look up as well as down! The wood structure in the eaves area may show indications of fungus decay. In coastal locations check the outer eaves-boards, where moisture collects and fungus infection is likely to occur. Watch for clogged "valleys" and eaves-troughs. If it is a two-storied structure and suspicious discolorations are in evidence, inspection from an extension ladder is indicated. In two-story apartment buildings, front, rear or side stairways are provided for access to the upper

level. If either the stairs or stair landings are enclosed by stucco, be sure to note the presence or absence of access doors and/or ventilation of the enclosed portions. If found to be inaccessible, these enclosed areas may be seriously attacked by either fungus, termites or both. During these exterior observations may be forgotten.

Exterior inspection of houses with concrete slabs is similar to crawl-space houses but there are certain points which should be stressed. The combination of high exterior grade and loose stucco is "dynamite" in slab construction. Planters are more often a hazard and vertical crack-in the main slab may result in both moisture penetration and infestation by subterranean termites. Open and inspect plumbing hatches and electrical meter and fuse boxes. Normal shrinkage cracks between porches and patios and the main slab should be inspected. Be sure to check concrete attachments installed by the owner. If these are poured without prior stucco removal they may present a serious hazard. Fence and gate posts adjacent to a slab-type house are hazardous, especially where the soil is built up in gardening

Inspection of the interior: Generally speaking, the condition of plumbing fixtures and plumbed appliances are the most important part of interior inspection. Although the stall shower is most often the prime offender, the inspector should not overlook a built-in tub which may have insufficient wall protection or calking. Leaking dishwashers, washing machines, water heaters, garbage disposals and/or the drainage systems under sink and washstands are always suspect.

Leakage of stall showers is a prime source of moisture accumulation. Many operators prefer to test for leakage by bucketing in the water for floor, pan and subdrain testing. Then, after checking conditions in the subarea beneath the shower they return to the bathroom and open both shower valves. Leaks in valve packing and wall-tile penetration will seldom be missed if this is done. Don't forget to check the toilet stool for leakage. This latter type of leak has the potential to rot out the entire bathroom floor in crawl-space houses.

Interior inspection of houses on slabs does not vary much from that in crawl-space homes. However, there are a few special points which should be stressed. Plumbing leaks will cause linoleum to loosen, asphalt tile to buckle or produce strains. Plumbing or conduit openings through the slab are point of entry for subterranean termites. These plumbing hatches may reveal fungus damage, subterranean termite activity, earth contacts due to burrowing animals or leaking pipe joints.

Attic area: If you note what appears to be a pile of sawdust on the upper plate near the eaves and you find it impossible to get close enough for a good look, moisten your hack saw blade and pick up a sample for accurate identification. Fungus infections due to room drain stoppage may be in evidence in these areas. The presence of buckets, pans and the like found in an attic generally indicates roof leaks. It is not uncommon to find shelter tubes of subterranean termites in portions of the attic directly above earth-filled porches, hearths and closed-in concrete patios. In recent years the presence of wood-boring beetle damage in the attic area has become more noticeable. Some of this damage may have occurred in the forest but the extensive building program of the last few years has allowed less time for lumber curing and active beetle colonies are not uncommon. This is especially true in the case of bark beetles.

While in the attic, it is a good idea to note any evidence of household insects or rodents. In many areas, opposums and even skunks have taken up residence in the attic areas of older, vine-covered frame houses. Silverfish, cockroaches, hornets, wasps, honey bees and especially birds and bats are frequently found in attics. When you have completed the inspection of the attic, obtain a moist cloth so that you may remove the finger marks from the exposed portion of the attic hatch.

In the event that no way of access into the attic can be found, estimate its accessibility from the exterior and recommend the cutting of a hatch if you are satisfied that sufficient clearance exists. Sometimes excessive bracing, roof additions and blown-in insulation limit the accessibility of the attic area and these facts must be set down in the notes. If the simple removal and replacement of a single brace or the opening of an abandoned roof section is all that is necessary to make the entire attic accessible, do not shirk your responsibility by failing to examine it.

Crawl-space inspection (substructural area): In the past, the conventional pattern of the subarea inspection was nearly always made in a narrow path around the under area adjacent to the foundation. An exception would be in the case of large buildings where cross-walls interfered. Although cross-walls are utilized under single-story structures, they are always found under bearing partitions in buildings of two or more stories. In contemporary homes, many things interfere with the so-called conventional pattern. These interferences are the relocation of appliances such as automatic washing machines, driers, water heaters and dishwashers, and the fact that bathrooms are not always contingent with the foundation as they always were in the past. Leaking water lines and plumbing connections may now occur several feet away from the foundation. Some of the worst offenders are side-opening dishwashers and condensation water in both washing machines and dishwashers where ventilation is defective. This permits a build-up of steam pressure within the appliance. We can no longer be satisfied with the fact that the plumbing along the foundation appears dry. All this points to a wider path of inspection and a route beneath each bath, half-bath or relocated water-connected appliance. Having already examined both the exterior and interior, the inspector should have the strategic points well in mind. Most likely these will be the location of earth-filled porches, patios, embedded vent-frames, planters, damp areas, bathrooms and water-connected appliance locations.

The general practice in checking an earth-fill porch is to slip a thin metal probe under the mudsill (sill) to locate either a void or the fill itself. If the probe penetrates the area beneath a porch cap freely, no "seal" exists; but if it strikes a hard surface back of the mudsill, a question arises as to the presence of a contact. In the latter case the earth fill is either sealed off or some structure has interfered and the seal is questionable. Where a porch seal is in question, make a diligent search for the presence of shelter tubes of subterranean termites before reaching any conclusion. Experience has shown that a probe may fail to penetrate all but a small sector so don't give up after a few tries—blade it all! Some inspectors use light-colored chalk or crayon to make arrows on the foundation indicating penetration points or evidence of infestation. These are valuable guides when reinspections are made at later dates.

Within reasonable slight-range, most vertical shelter tubes of subterranean termites attached to the foundation and free-standing swarmer tubes are readily visible. One must be much more alert to spot horizontal tunnels extended along the mudsill, in subfloor cracks, at the edges of blocking and those extending along floor joists and girders. If possible the latter should be traced to their point of origin. The colony may have originated in an earth fill, an exterior plant, an embedded exterior vent-frame, a vertical foundation crack, some loose stucco, a wooden structure attached to the house or some other earth-to-wood contact.

Good visibility cannot be obtained at distances or more than 15 to 18 feet. Therefore, if the structure exceeds 36 feet in width, one or two extra routes traversing the central portion become necessary.

Some locations in the subarea which should be given particular notice are: areas directly beneath floor furnaces, soil pipe openings through foundations, wood forms or stakes left in place by the builder, cellulose debris, tree stumps, plumbing or heating ducts supported on wood blocks, moist areas, vertical foundation cracks and piled-up earth. Check carefully under the stall shower which has been previously water-tested. If it is damp or dripping, determine the source of the leak. Probe the subfloor for softness. This goes for stained areas whether dry or wet. Where one-inch subflooring is used, it may be necessary to arrange the removal of a section to reach a verdict. Don't overlook the flooring and joists directly beneath the toilet stool. Although everything may appear to be in good condition in the bathroom the real story will reveal itself directly beneath the stool. Dry dormant fungus decay beneath a toilet indicates that the toilet was reset without floor repair. Such a condition is a serious hazard because a new leak will reactivate the fungus development.

Garages: One of the primary problems involved in garage inspection is storage. If the inspector cannot reach all the strategic portions of the garage due to storage, make note of this and suggest a supplemental inspection and report when these portions can be made available. Sometimes garages are partially or completely "finished" on the inside and except

for the door and doorjamb, a garage like this may be inaccessible for inspection. Flat-roofed garages are subject to fungus decay adjacent to the drain or downspout area. The header above the door is a spot that is easily missed, especially when there is an open overhead door. Shrinkage cracks adjacent to the foundation and diagonal cracks passing under the mudsill are definite garage hazards.

Some garage owners have built-in colonies of drywood termites with infested shelving, storage rooms, benches and the like. Sometimes infested stored furniture and firewood may be the source of the garage infestation of drywood termites or wood-boring beetles. Small temporary-type structures built onto the sides or rear of the garage may not be properly insulated from the ground. Where the garage is an integral part of the house, it becomes as important to inspect as any other portion. If the garage is used as a laundry, check all water-connected appliances. A locked garage generally means a supplementary inspection and report unless the owner refuses to permit the inspection. In this case, explain the circumstances in your report. High exterior grade conditions and piles of trash or stored lumber adjacent to the outer walls of the garage are definite hazards.

SELF-HELP QUESTIONS

Now that you have studied this manual, answer these questions. Write the answers with pencil without referring back to the text. When you are satisfied with your answers, see if you are correct by checking them in the text. Erase your answer and write in the correct answer if your first answer is wrong.

1. What forms of termites are usually seen outside of ther tunnels?

2. How do you distinguish termites from ants?

3. What kinds of castes do termites have?

4. What are the five basic steps in termite control?

5. Are dampwood termites native to Michigan?

6. Where do drywood termites make their nests?

7. What major factors of wood affect the development of lyctid beetles?

8. What is the best way of identifying lyctid damage?

9. List five means of preventing lyctid damage.

10. How can you tell if an anobiid infestation is still active?

11. Is the old house borer a pest in hardwoods or in softwoods?

12. How long does it usually take the old house borer to complete its life cycle?

13. Is the wharf borer found in decaying wood?

14. Why is the wharf borer adult a nuisance?

15. Can ambrosia beetles infest drywood?

16. Why is the bark beetle a nuisance in homes?

17. What is the food of carpenter ants?

18. How much moisture in wood is required before fungus can attack the wood?

19. What equipment is needed to properly inspect a building for wood pests?

20. What exterior areas of a building should be especially well checked for signs of wood pest damage?

21. What plumbing fixture is a prime source of moisture accumulation?

22. Why has damage from wood-boring beetles increased in recent years?

23. What locations in the substructure should be very carefully inspected for moisture and wood pests?

24. What wood pest is of special concern in flat-roofed garages?

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