Other Disorders

Healthy colonies do not tolerate the presence of dead brood and will remove it as quickly as possible. Seriously weakened colonies should be strengthened or united with stronger colonies to hasten removal of dead brood from the combs.

Poisoning

The first sign of poisoning usually is the appearance of a large number of dead or dying bees at colony entrances throughout the apiary. A knowledge of local pesticide programs and of blooming plants that are toxic to bees is important in avoiding poisoning.

Pesticide injury. Some pesticides kill larvae in all stages as well as adult bees. Pesticide dusts are particularly hazardous because of their greater tendency to drift and their propensity to stick to bee hairs. If pesticide damage is suspected (fig. 13), the beekeeper should immediately file a Report of Loss with the agricultural commissioner of the county in which the damage occurred so that the loss can be recorded and investigated properly. Beekeepers can request the commissioner's office that they be notified when pesticides they consider particularly dangerous to their colonies are going to be applied in their area — they will be given a 48-hour warning. A publication that includes information on the potential hazards of specific pesticides to bees can be obtained at any farm advisor's office.

Poisonous plants. California plants producing nectar or pollen poisonous to bees are: California buckeye (*Aesculus californica* [Spach] Nutt.), death camas (*Zigadenus veneosus*), cornlily (*Veratrum californicum*), and locoweed (*Astragalus* spp.). Because of its wide distribution, buckeye is the most hazardous to bees.

Symptoms of buckeye poisoning usually appear about a week after bees begin working the blossoms. Many young larvae die, giving the brood pattern an irregular appearance. The queen's egg-laying rate decreases or stops, or she may lay only drone eggs; after a few weeks, an increasing number of eggs fail to hatch or a majority of young larvae die before they are 3 days old. Some adults emerge with crippled wings or malformed legs and bodies. Foraging bees feeding on buckeye blossoms may have dark, shiny bodies and paralysislike symptoms. Affected colonies may be seriously weakened or may die. However, the

Fig. 13 Bees killed by pesticides.

queen may resume normal egg laying, if the colony is moved from the buckeye area.

Honey produced from California buckeye is not poisonous to humans. (Oddly enough, neither is honey produced from poison oak.)

Brood disorders

Chilled or starved brood. Chilling usually occurs in early spring when a severe drop in temperature follows warm weather — this causes the bee cluster in the hive to contract and no longer cover brood in peripheral portions of the brood-rearing area. Chilling also can result from separating brood combs from the main brood-rearing areas or from neglect by worker bees if too many bees are lost to pesticides or other causes. Brood dead from chilling or starvation will be found in a clearly defined area, not scattered among healthy brood. All stages of brood in the affected area will be dead. Dead brood is gray, brown, or black and has a slightly sour odor; it is easily

removed from cells. Symptoms usually disappear with warmer weather, with supplemental feeding, or with the beginning of a nectar flow.

Overheated brood. Brood dead from overheating resembles brood dead from chilling or starvation. When such brood is found at the same time that older larvae are observed crawling outside their cells, overheating has occurred. To prevent this, bees should have adequate ventilation, an ample supply of water, and shade.

Dead drone brood in worker cells. If a queen bee lacks sperm, she will lay only drone-producing (unfertilized) eggs. If no queen is present, worker bees sometimes will lay eggs, but these will be unfertilized, also. This drone brood, which occurs in irregular patches with domelike caps, is often allowed to die. It may be found in various stages of decay, usually in moist, pasty, brown patches having a sweet-rotten odor.

Other problems

Queenless colony. A colony without brood during the active season normally is queenless. Queenless colonies usually become very disturbed when the hive is opened. Scattered cells of pollen with a glossy appearance, found in the area normally occupied by brood, is the typical indication of a queenless colony.

Dysentery. This is a functional disorder that may result from eating indigestible food during a prolonged period of confinement. The most noticeable sign of dysentery is fecal matter in the hive or around the entrance, as bees normally void their body wastes while in flight outside the hive. Honeydew, unripened honey, overheated honeys, or fermenting sugar syrup are unsuitable as feed and will cause dysentery if bees are unable to make frequent flights to void body wastes (as is common in winter).

Starvation. Starvation is a major cause of colony loss in winter and spring, but can occur at any time of the year. Conclusive proof of starvation is the presence of clusters of dead bees, stuck head first in comb cells where they have died in search of food. Often, colonies that have produced a large amount of early brood deplete their stores and die of starvation during confining weather in spring. Colonies also may starve later in the season if subjected to a prolonged dearth between nectar flows.

The most obvious sign of approaching starvation is loss of hive weight or absence of sealed honey during a nectar dearth. Starving bees are restless and crawl slowly about the comb as though cold, even though the weather may be warm. Egg laying is retarded or ceases entirely, and brood is neglected and allowed to die. Cappings sometimes are removed and the brood eaten. Starving bees occasionally cluster in a hunger swarm, usually on or near the hive.

Pests of Bees

Wax moth

The greater wax moth, *Galleria mellonella* L., occurs in all areas of California and is active year-round in coastal and southern California. Night-flying female moths (Plate III) lay eggs inside and outside beehives, showing a preference for stronger colonies. Wax moth larvae tunnel through the combs chewing up the wax and obtaining nutrients from pollen, cocoons, and other debris. Without control, wax moths can reduce combs to a mass of webbing and fecal pellets.

Fortunately, honey bees are capable of locating and removing wax moth larvae before they do much damage, as long as the colony is strong and is not given too much space to patrol. Any supers of combs brought in from the field for storage are very likely to be infested. If a good-sized deep freeze is available, exposure to freezing temperatures for a day or two will kill all life stages of the moth. Otherwise, beekeepers rely on fumigation with various chemicals to kill wax moths. (Chemicals and biological control agents currently registered for wax moth control and their use are explained in the box, *Materials Registered for Wax Moth Control*.)

Other, smaller moths, commonly encountered as pantry pests, will invade stored honeycombs, also. However, these moth larvae usually cause much less damage to the comb and are eliminated by most treatments effective for greater wax moths (but not Certan).

Ants

Normally, a stong, healthy colony of bees can repel an attack by most types of ants. However, in California, Argentine ants are capable of destroying nuclei and full-strength colonies. Often, the ants begin foraging on nectar and honey. Lines of marching ants can be seen leading to the hole they use to enter and leave the hive. Before long the bees become demoralized by the ants and fail to forage properly. This is detrimental to the colony and to the grower, if the bees are being rented for pollination. Left unchecked, the ants often move their headquarters directly below the hive, continue to remove honey and pollen, and eventually begin eating the brood. The bee colony will perish.

Beekeepers use two approaches to ant control: physical barriers and insecticides. Where practical, hives

can be placed on low stands that have a can of water or oil at the base of each leg. Water evaporates quickly without a thin layer of oil on it. When cans go dry, become filled with floating dust or debris, or are circumvented by a grass-blade bridge to the hive, the ants will be back in no time.

Various forms of ant baits are on the market in small individual containers and are more or less successful, depending upon what else is available to the foraging ants. A number of insecticides are labeled for controlling ants on the ground, but remember that bees are susceptible to the chemicals, also. Be sure to use insecticides cautiously around bees. (See also *An Observation Beehive*.)

Bears

Insects make up a substantial portion of a bear's normal diet, so it is not surprising that bears will tear open beehives, wild or human-made, to seek out the brood for food. Bears also like honey.

Beekeepers can protect their hives adequately with well-constructed

MATERIALS REGISTERED FOR WAX MOTH CONTROL

Certan. This is a wax moth-adapted strain of *Bacillus thuringiensis* that can be sprayed on combs. Coverage must be thorough and older larvae are much less susceptible to the bacterium than younger larvae. Bacterial spores should be effective for 12 months if temperatures remain reasonable. Bees clean the spores off the combs and contamination of honey is no problem.

Aluminum phosphide. A fumigant formulated as a slow-release, dry, solid pellet or tablet. Easy to use in a reasonably moist environment, it provides excellent penetration of supers and combs, killing all life stages of the moth, if fumigant concentration is held at adequate levels long enough. The highly volatile gas escapes quickly from tiny exit holes in fumigation chambers and has given poor results in a number of warehouses that were not well sealed.

Paradichlorobenzene (PDB). Effective on larval and adult stages, but eggs survive. Covered stacks of five or six deep supers or ten shallow supers (empties, only) are treated with 3 ounces of crystals. At least two treatments at 4- to 21-day intervals are needed to eliminate newly hatched larvae. Combs must be "aired" adequately before use to prevent problems with bees.

electric fences in areas where native bears are known to roam. However, once a bear has become accustomed to destroying hives, it takes much more than a fence to eliminate the habit. It is much easier to inquire about bears at the local county offices before moving into an area than to try to deal with the problem later.

Skunks

It does not take a skunk long to learn that bees crawl out of a hive entrance if the hive is scratched at night. The bees become tangled in the skunk's hair, and the skunk eats them. Toenail scratches on a hive or, sometimes, a hole being excavated under a side of the hive indicate skunk activity. Repeated visits to the same hive can detrimentally affect the population and colony morale. The latter effect will become very evident to the beekeeper when the hive is opened! Skunks can be trapped, but use of poisons for skunk control in California is illegal.

Mice

As the weather becomes cooler in fall, field mice seek protected places to overwinter. Stacks of stored bee combs, or even the lower, empty boxes of combs in hives from which the cluster has moved up, are attractive to mice. A mouse nest usually involves four or more combs hollowed out to support dried grass, leaves, and bits of cloth used to build the nest. By spring, the family has increased in numbers and the odor has become unacceptable.

Entrance guards of 3/8-inch mesh hardware cloth will protect hives in the field, and tight-fitting pallets and covers should protect stored combs.

Livestock

Occasionally, cows and other livestock may push a hive to see what it is or they will use it to scratch an itch. Normally, the hives are disturbed only once. It is best to avoid direct contact with horses since they react violently to beestings, prompting more stings and leading in some cases to severe self-injury.

Vandalism

Vandalism often is avoided by placing the apiary in clear view of passersby and by posting a notice to the effect that witnesses to vandalism will receive a reward for supplying evidence leading to the vandal's prosecution. Various California beekeeping organizations provide such posters to their members.

An Observation Beehive

Few hobbies are as exciting and as educational as keeping a colony of bees in an observation hive. The behavior of bees as a social unit and their elaborate means of communication can be used to illustrate basic biological concepts in teaching at all levels from kindergarten to college.

Once the colony is established behind glass walls, anyone can visually enter the world of the honey bee to observe the activities of an intriguing society. All of the honey bee's life in the hive is unveiled, from egg laying by the queen to the emergence of newborn worker bees from cells in the comb. Some bees will be seen processing pollen into bee bread, others will be converting nectar into honey, and many other worker bee activities, such as cleaning the nest, building comb, and exchanging food, can be seen night and day. But perhaps the most fascinating sight is that of the worker bees returning from foraging trips heavily laden with brightly colored pollen pellets as they enter the hive and perform dances that tell other workers where the pollen was gathered. (As an added bonus, bees in a four-frame observation hive may produce up to 20 pounds of honey annually.)

To fully appreciate an observation hive, you should have some background knowledge about the biology and behavior of honey bees. Many excellent books on bees are available, and a few hours of reading some will pay great dividends.

The hive itself should be located so as to permit observation from both sides. Access must be provided from the hive to the outdoors so that the bees can forage for food and water. A transparent runway through the wall or a window will provide for this. Ideally, there should be no sidewalks or parking areas within approximately 30 feet of the exit. Runways can be of considerable length and can be built to turn corners or curves, although bees seem to orient better if they can see light at the runway's exit.

Construction and mounting (fig. 14)

Observation hives can be purchased, but the hive described in this text is economical and simple to construct and will accommodate four standard full-super frames. Bees need this amount of space for clustering, rearing brood, and storing food reserves.

Ideally, the hive base should be mounted rigidly to a sturdy table or

platform. Because all manipulations of the colony must be made outdoors, the mounting and runway attachments should be made so that the hive can be disconnected easily. Before the bees are installed, temporarily mount the hive in its permanent position and then construct the runway to the outdoors. Runways can be made with parallel wood strips on a wooden floor and covered with glass, Plexiglas, or plastic. Fibrous material, such as cardboard, paper, or cloth, should never be used; bees chew through these materials in a few days.

Sometimes there is a problem in making an opening through the window to accommodate the exit runway. One solution is to replace the window glass with a sheet of Plexiglas or plywood in which an opening can easily be cut. For an attractive installation, paint all wood parts (except the frames) of the hive and runway before the glass or plastic is mounted. White observation hives are most attractive, but any color is satisfactory. Paint should be dry before bees are placed in the hive.

Establishing the colony

Bees may be installed in the observation hive anytime between

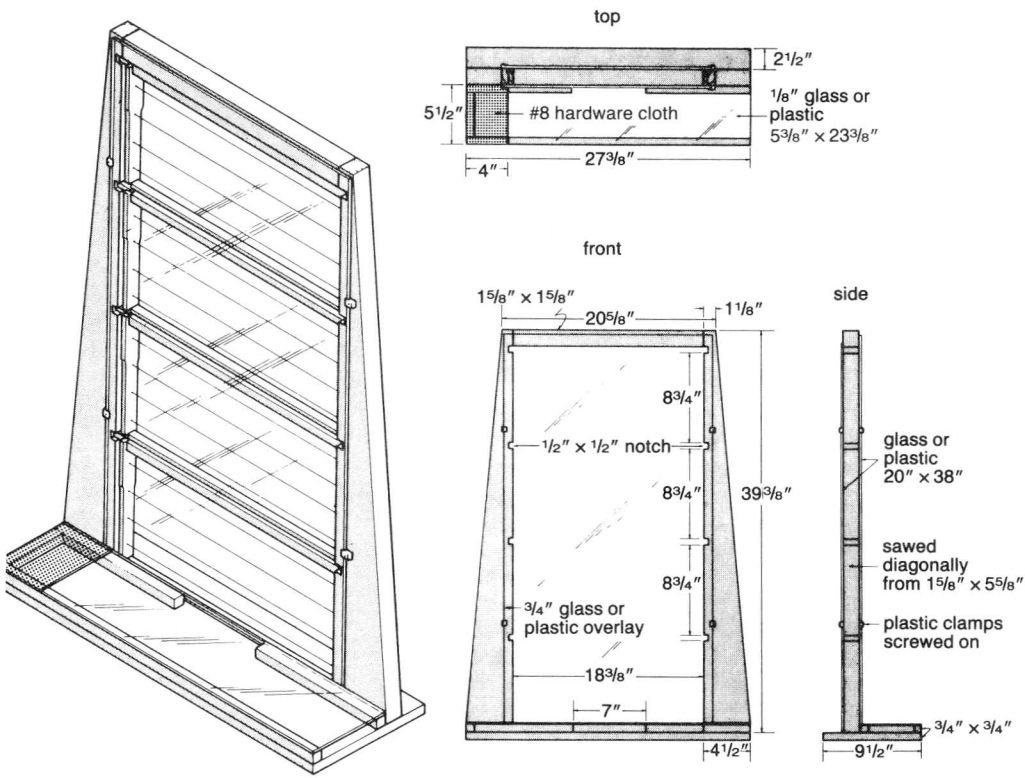

Fig. 14 An observation hive, with construction details. Commercial observation hives are available, also.

early spring and midsummer. Worker bees may be purchased along with the queen; approximately 3 pounds of bees are sufficient.

The quickest method to establish an observation hive is to put frames of brood and a queen from a conventional hive into it. Once the queen is inside the observation hive, the temporarily disorganized bees (including those outside the hive) will soon find the queen and cluster around her.

Instead of purchasing packaged bees, a swarm may be captured and installed. During the swarming season each spring, various public agencies (police, fire department, county agricultural agencies) receive numerous requests to remove swarms, and they frequently are willing to place applicants' names on a "swarm waiting list."

Installing a swarm. Lay the observation hive (containing frames) on its side with the runway side up, propping the top of the hive on a box approximately 1 foot high. Loosen the plastic mounting clamps on the upper glass wall and slide the glass approximately 1 foot toward the hive top. Then shake the cluster of bees into the opening and gently slide the glass wall into position, being careful to avoid crushing bees. Inevitably, a few bees will not get into the hive, and these should be checked to see if the queen is among them. If the queen is among them, she should be captured and placed in the hive.

Installing packaged bees. Prepare the hive as in the instructions immediately above. Now, lightly sprinkle water on the wires of the package — this will calm the bees. Rap the package so that worker bees will fall to the bottom, and then remove the queen cage from the package. One end of the queen cage has a hole with a cork disk over it; remove this disk, exposing the candy beneath it. Place the cage inside the hive near the lower frame, making sure that the cage's screen can be reached by worker bees (they will have to feed the queen through the screen for a few days).

Now shake the bees into the hive and slide the glass wall shut. The bees will be attracted to the queen and will eat the candy that blocks her exit from the queen cage, thus freeing her. If the cage is not supplied with candy, the queen should be released immediately. The empty cage can be removed when convenient.

Transferring bees from conventional hive to observation hive. Remove two frames of capped brood, one frame of honey, and one frame of empty comb from a conventional hive (all frames should be covered with bees). Place them in that order, bottom to top, in the observation hive. Shake additional bees from the conventional colony into the observation hive. Make certain that the queen has been transferred.

Maintaining the hive

After the newly established hive is mounted, a feeder containing sugar syrup should be provided for the colony. Feeders can be made by punching or drilling 20 to 50 small holes in the lid of a pint or quart glass jar; the jar should then be filled with sugar syrup and inverted over the feeding chamber. Sugar syrup should be made available continuously until all the combs are filled with honey or brood. Thereafter, the colony should be fed only when its stored honey is gone.

Under normal conditions established colonies are self-supporting

and require little maintenance. However, colonies in observation hives require special maintenance because there are fewer foragers than in the regular hive. When weather conditions permit foraging flights, and nectar and pollen are available, the observation colony collects nectar rapidly and accumulates an abundance of honey, which reduces the need for maintenance.

Preparing the colony for winter. Unless the climate permits bee flight at least once a month, it is not advisable to try to maintain an observation colony in winter. Without periodic flights, high mortality usually occurs, and the colony may die in midwinter or early spring. Therefore, it is usually best to terminate the colony in autumn after brood rearing has ceased (the queen can be removed earlier if desired). This is done by shaking the bees off the observation hive frames near the entrance of a normal outdoor colony. The bees will soon be accepted into the colony. The frames of combs from the beeless hive may then be wrapped and stored at 0°F; this prevents granulation of honey and infestation by pests during storage. The following spring a colony may be reestablished in the hive, using the stored frames of comb.

Problems and solutions

Although honey bees are largely self-sufficient, minor difficulties may arise occasionally. These are discussed below.

Sunlight. Observation hives should never be exposed to direct sunlight.

Ventilation. Normally, the observation hive will have adequate ventilation through its runway to the outside and additional ventilation ports will not be necessary. However, if the inside of the hive walls becomes fogged for a prolonged period, additional ventilation ports (3/4-inch holes covered by 8-mesh wire screen) may be provided on the top or ends of the hives. Healthy colonies typically are full of bees, and it is a mistake to suppose that bees need additional ventilation simply because they appear to be crowded.

Swarming. In spring colonies increase rapidly in population, and swarming is therefore to be expected. Hobbyists may wish to study this phenomenon, but if they wish to prevent it, the easiest control is to kill the old queen (by pinching her head) when the colony population reaches its peak in spring. A new queen will be reared automatically by the bees, and the short interruption of brood rearing normally stops swarming tendencies for the remainder of the season.

Invasion by pests. In some areas ants are serious pests of bees; colonies invaded by ants are liable to become disorganized enough to stop normal activities. Poisonous baits for ant control may be used near the colony, but access by bees (or other animals) to baits must be prevented by covering bait containers with 8-mesh wire screens, which should be at least 1/2 inch from the bait itself so that bees cannot reach through and eat the bait. Do not use insecticides near the hive.

Population decline. Except for normal seasonal fluctuations, a decline in bee population usually is caused by insufficient brood rearing. Usually, the hive population is stable; hundreds of new bees emerge each day and compensate for normal losses (bees live 6 to 8 weeks in summer and up to 6 months in winter). If

brood-rearing decline is caused by an old and inferior queen, replacing the queen is usually the best solution (see requeening in *Maintaining Genetic Stock*).

Lack of food. The threat of starvation is greatest when rapid consumption of hive food supplies occurs during the intensive spring brood rearing. If the hive contains enough capped cells of honey, bees will not starve. If capped honey is not present, sugar syrup must be fed to the colony.

Accidential bee escapes. Because they are confused, bees accidentally released indoors usually do not sting. However, stinging may occur near the colony within a few seconds after bees escape, particularly if thousands are liberated suddenly. If this happens, permit the colony to settle down for a few minutes. After the bees have become settled, the hive and any adhering bees may be gently taken outdoors. (Any bees remaining in the building may be caught easily with a vacuum cleaner.) Whenever the colony is carried outdoors, always remember to plug up the runway at the point where it is disconnected from the hive.

Orientation of bees. Observation hive bees can become disorganized (disoriented) when they are installed, or after any change in the arrangement of the colony runway. Disoriented bees in a hive seem to be wandering about and do not perform any of the chores they usually do. Several days may be required for forager bees to adjust to a new location or runway arrangement. Young bees just learning to fly may be seen in intensive flight around the hive entrance in early afternoons; this is their method of orienting themselves to the colony in preparation for later foraging.

Use of smoker and protective clothing. To control bees, a few gentle puffs of smoke should be blown into the hive entrance just before the top of the hive is removed. When smoke is applied skillfully and in small amounts, the risk of being stung is minimized; however, one should always move slowly and carefully around bees — fast motion, strong vibrations, or any jarring of the hive excites them.

Glossary

Abate
To eliminate a (disease) problem by removing (often by burning) or treating bees and beekeeping equipment so that there is no possibility of contaminating other bees.

Acid board (also ***Fume board***)
A rimmed hive cover containing a pad of absorbent material into which benzadehyde or butyric anhydride (bee repellents) is poured. Used to remove bees from honey supers.

Apiary
A collection of one or more populated beehives at a certain location.

Bee bread
Bitter, yellowish pollen stored in honeycomb cells and used by bees for food.

Bee escape
A mechanical device that allows bees to pass through it in only one direction. Often a leaf spring or cone design used to eliminate bees from particular supers in a hive or from buildings.

Bee glue
See *Propolis.*

Beehive
Normally refers to a human-made container in which the colony lives. Movable frame hives are required by law in California (see *Hive*).

Beekeeper
An individual who oversees the maintenance of one or more colonies of bees.

Beesting
The apparatus at the tip of an adult female bee that can inject venom into the victim being stung. The worker sting remains in the victim and continues to inject venom; it should be scraped off sting site.

Beeswax
Wax secreted by glands located on the underside of four abdominal segments of the honey bee. It is used by bees to construct comb.

Boardman feeder
A small, wooden feeder placed at the hive entrance and holding an inverted pint or quart glass jar of sugar syrup. Not recommended.

Brood
Any immature stage of development: egg, larva, or pupa. Also, collectively, all immature bees in the hive.

Brood comb
Any drawn comb in which eggs, larvae, or pupae are found.

Brood nest
The area inside the hive body devoted to brood rearing.

Brood rearing
The process involving egg laying, feeding larvae, and keeping pupae warm, which produces more adult bees.

Cappings
A thin layer of wax covering ripened honey or developing pupae. Cappings are collected when honey is being uncapped. Capped brood refers to pupae.