

Choosing Bees

Most bees reared in California today are Italian or "yellow" bees. Italian bees are noted for good wintering and for extensive brood rearing, which can be beneficial before a good honey flow or detrimental during a honey dearth. The Caucasian or "dark" race of bees is preferred by some beekeepers because these bees tend to be calmer and more gentle when examined. However, Caucasians tend to collect and liberally distribute large amounts of propolis (or bee glue) throughout the hive, thereby making it more difficult to pry the hive components apart.

It is sound practice to purchase commercial queens and bees from reputable breeders. Avoid spending extra money on exotic strains and expensive hybrids until enough experience has been acquired to ensure persistence of your colonies from year to year. Bees can be obtained by: (1) buying a colony in a hive, (2) buying a nucleus, (3) purchasing a queen and bulk bees in a package, and (4) hiving a swarm.

Buying a colony in a hive

This is the easiest way to get started. With the bees already in the hive, it is not necessary to hive them

(put them into a hive), as must be done with packaged bees, nuclei, or swarms. *Before it is purchased, the colony should be inspected by the county bee inspector to be sure it is free of disease.*

Buying a nucleus

A nucleus generally consists of three to five frames with bees (6,000 to 10,000 bees), including a laying queen and her brood. Nuclei are transported to hives in mini-hive boxes. Frames and adhering bees are transferred from each nucleus, in identical sequence, into the center of a hive body and surrounded by empty drawn combs or frames with foundation. If stored food is in short supply, the bees should be fed (see *Feeding Bees*).

Buying and installing packages

Packaged bees consist of wire-screen cages in which are confined 2 or 3 pounds (7,000 to 10,000) of worker bees, a queen in a separate small container, and a feeder can of a syrup that is made up of equal parts of water and sugar. Packages can be purchased from a beekeeper or from a bee supply company. Order

packages to arrive in spring, 2 to 3 months before the principal nectar-producing plants bloom in your neighborhood. This gives the bees time to build a population large enough to take full advantage of the nectar and pollen when it becomes available.

When the packaged bees arrive, sugar syrup should be sprayed or shaken onto the bees through the screen sides of the package. Give them all they will consume, but not so much that they become stuck together in a mass. The bees can be installed immediately into the waiting hive if it is a cool and cloudy day. If it is warm and sunny, store the bees in a cool, dark room until just before dark. Then, after spraying the bees with syrup again, install the bees in the hive.

Packaged bees are best installed by the "direct release" method, as follows:

- (1) Loosely obstruct the hive entrance with a small amount of grass.
- (2) Remove four central frames from the hive body.
- (3) Pry off the board covering the feeder can on the package.
- (4) Rap the package on the ground with sufficient force to knock the cluster to the bottom of the package.
- (5) Remove the feeder can and the queen cage.
- (6) Lightly spray the bees with syrup if you wish.
- (7) Invert the package and roll and jounce the bees out through the round hole into the space between the frames in the hive.
- (8) Gently spread out the pile of bees on the bottom board with a hive

tool as soon as most of the bees have been dumped out of the package.

- (9) Spray or dip the queen in sugar syrup, wetting her wings so she cannot fly.

- (10) Without gloves, reach down into the hive and pull the screen off the queen cage.

- (11) Place the queen cage against a comb or sheet of foundation and watch the queen as she leaves her cage. She should climb down and go around to the back side of the comb.

- (12) Carefully replace the four frames to avoid accidentally injuring the queen. The few bees left in the package will rejoin the group in the hive as soon as the bees remove the grass from the entrance.

This procedure brings the beekeeper very close to the bees. However, packaged bees are quite young and momentarily disoriented so they very rarely sting beekeepers while they are being installed from packages.

Hiving a swarm

Hiving a swarm (catching bees and putting them in a hive) is difficult for a beginner without help from an experienced beekeeper. It is the least expensive way to start beekeeping because swarms usually can be obtained free simply by leaving your name with the county agricultural commissioner, fire department, police department, sheriff, farm advisor, or animal control center.

Newly hived bees should not be disturbed for several days, except to refill the syrup feeder. The queen should begin to lay eggs in a week or less and the colony will start its

work. Abundant pollen is necessary for the colony to use as food for rearing brood, feeding the queen, and feeding the drones. Pollen normally is collected from nearby flowers, but when pollen and nectar are not available, it becomes necessary to supply colonies with nutrients. (See *Feeding Bees*.)

Catching swarms has inherent drawbacks: (1) The queen has a tendency to swarm and is likely to do it

again, (2) the likelihood of collecting inferior stock (even Africanized bees, eventually) is much greater with swarms than with purchased bees, and (3) the possibility exists that the swarm is carrying contaminated honey with it and a bee disease may break out in the colony. Even though swarming and swarms are intriguing, they are not a very good source of bees for your colonies.

Choosing Equipment

Equipment needed for beekeeping is available from national beekeeping supply dealers and their local representatives; consult the yellow pages of the telephone book. You will need:

The hive (figs. 1 and 2)

- ☐ Two deep hive bodies or equivalent
- ☐ Bottom board
- ☐ Cover
- ☐ 10 frames, with foundation, per hive body
- ☐ L-shaped metal rabbets or frame rests (optional)
- ☐ Honey supers, with frames and foundation (optional)
- ☐ Queen excluder (optional)
- ☐ Honey extractor (optional)

Bee stock

- ☐ One 2-pound package with one queen per hive

Personal equipment (fig. 2)

- ☐ Smoker
- ☐ Hive tool
- ☐ Bee veil
- ☐ Gloves (optional)
- ☐ White coveralls (optional)

Hive components

Use only standard size 8- or 10-frame hive equipment (dimensions in fig. 3) so that all parts will fit together properly and match commercially manufactured products. The basic unit of the hive is called a

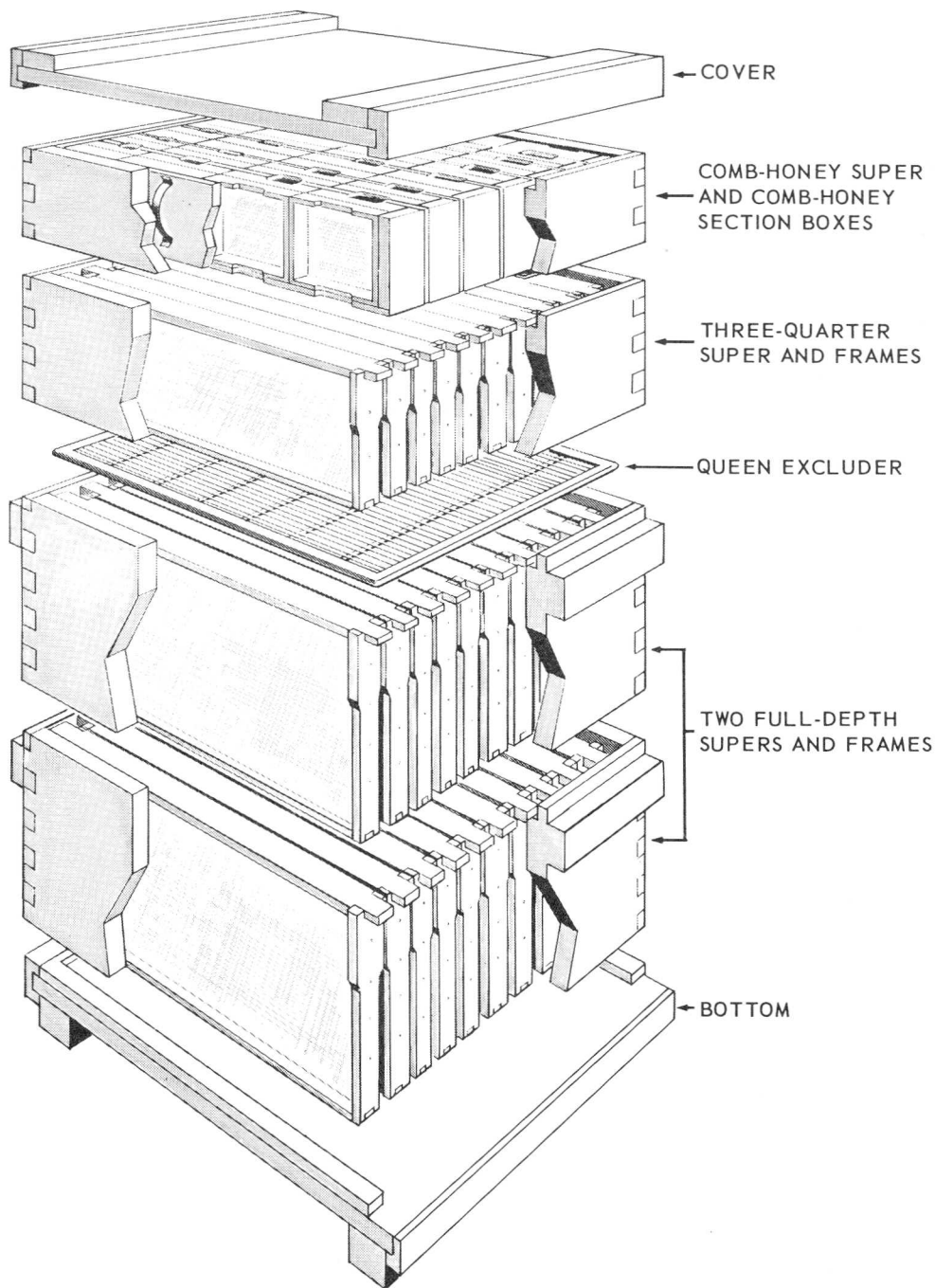


Fig. 1 Beehive detail, showing optional parts used in different types of bee management.

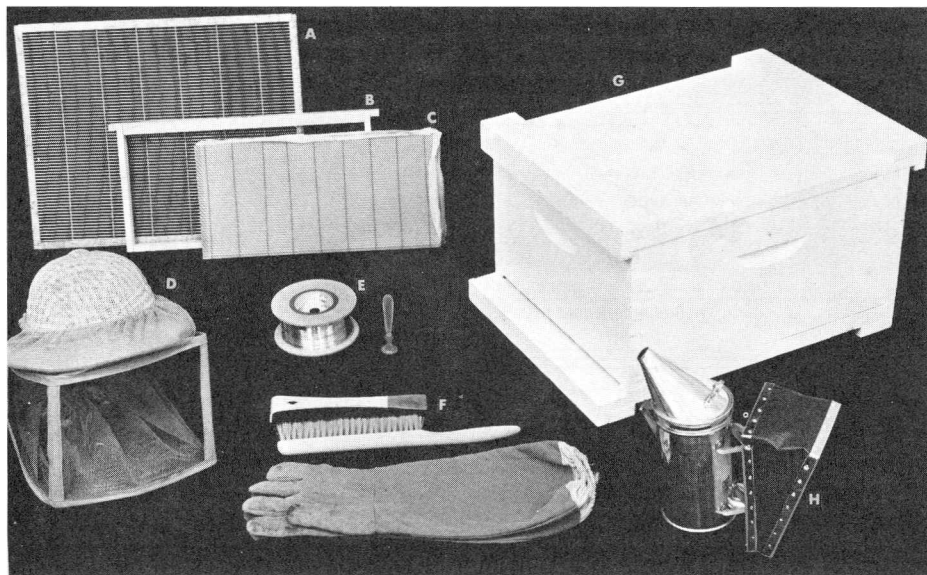


Fig. 2 Basic beekeeping equipment: (A) welded wire queen excluder; (B) frame; (C) vertically wired beeswax foundation; (D) hat and wire veil; (E) wire for frames and spur embedder; (F) hive tool, bee brush, and gloves; (G) 1-story, 10-frame hive; (H) smoker. All these items are available commercially.

hive body. A hive body is designed to hold ten (or eight) full-depth ($9\frac{5}{8}$ inches deep) frames on which the bees will rear their young and store food. A colony eventually will get large enough to cover all ten frames and will require at least two hive bodies to hold all the brood and bees. Boxes placed above the brood nest for storage of honey are called supers. Supers may be full depth, medium, or three-quarter depth ($6\frac{5}{8}$ inches deep), shallow ($5\frac{3}{4}$ inches deep) or comb honey ($4\frac{5}{8}$ inches deep). The type of super selected depends upon the type of honey being produced (see *Producing and Marketing Honey*) and the ability of the beekeeper to lift filled boxes.

Each hive body and super originally should be filled with a full set

of ten (or eight) frames designed to fit the box. Each frame should have a sheet of the proper size and type foundation firmly attached to the top bar. The bees will follow the pattern embossed on the foundation when building beeswax combs. After all the combs are drawn out fully, one frame can be removed from a ten-frame hive body and the remaining nine frames spaced evenly across the box so that the frames can be manipulated more easily.

Foundation. Commercial foundation is sold in many sizes and types. To assure a proper fit, purchase the frames and foundation from the same supplier. Generally, there are two types of foundation: wired and plastic. Wired is designed for strength and is used for brood combs

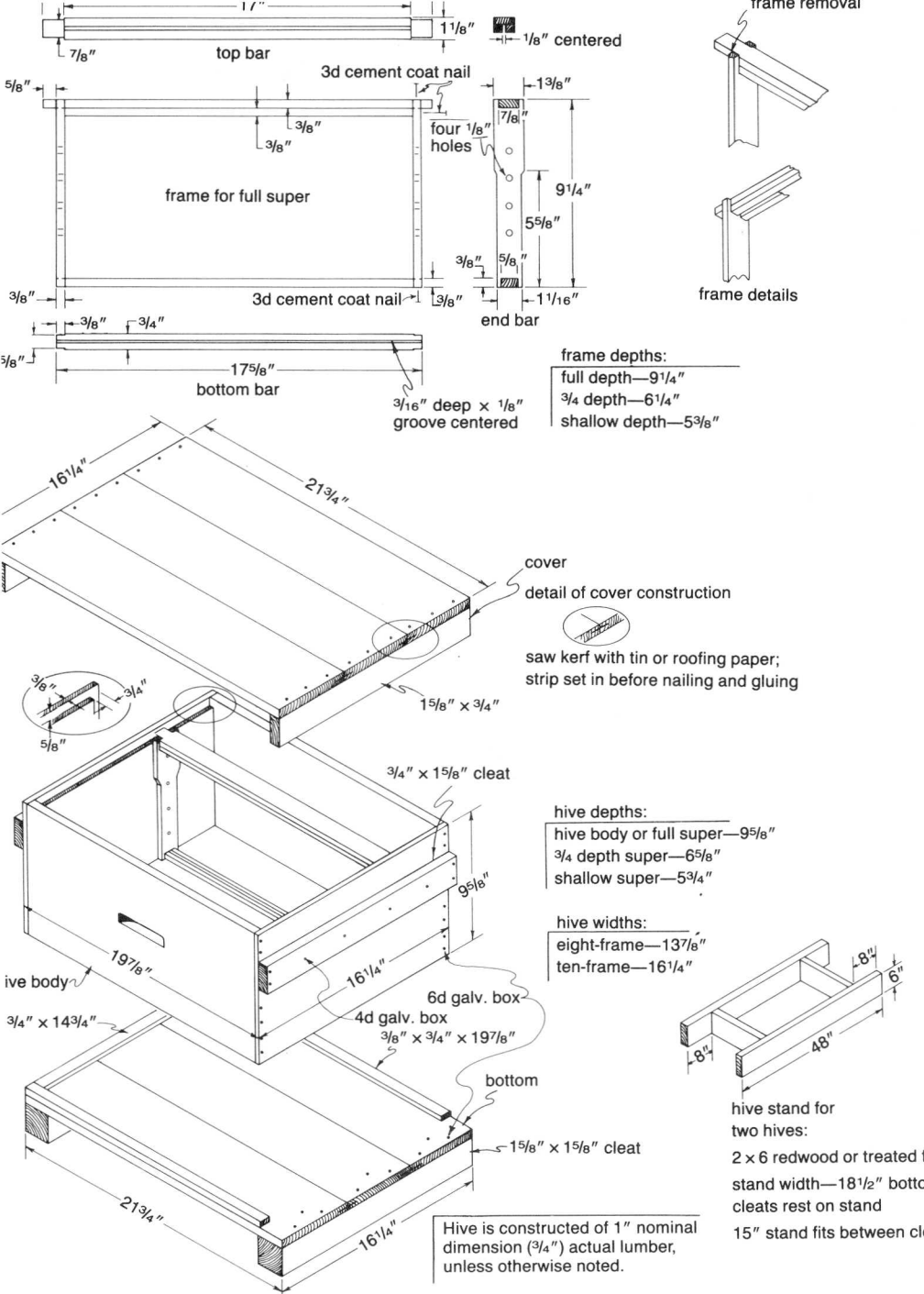


Fig. 3 Dimensions of standard beehives and frames.

and extracting combs. The foundation is thick and reinforced with vertical wires or a plastic midrib. The vertically wired foundation must be supported by additional horizontal wires to avoid sagging under the weight of brood and stored food. Beekeepers can avoid the use of wires, embedding tools, and other problems by using a plastic foundation, which snaps into place, or plastic combs, which combine frame and foundation.

Wiring jig. Beekeepers can purchase or make a jig for wiring frames and embedding wires in beeswax foundation (fig. 4). Best results require use of eyelets in endbar holes to prevent the wire from cutting into the wood. The jig holds a nailed frame under slight end-to-end pressure while No. 26 tinned wire is threaded through the holes and around small spools. One end of the wire is wrapped around a tack which is driven in. The wire is slipped off the small spools, pulled tightly, wrapped around the other tack, and driven tightly. Then it is snipped, usually by bending it back and forth repeatedly.

A jig can be modified to hold an insert that fills the space in the middle of the frame. When a wired frame is placed over a sheet of foundation lying on the insert, the insert presses the foundation up against the wires. An electric train or doorbell transformer should be used to supply the electricity needed to heat the wires and melt them into the wax.

Edible foundation. Beginning beekeepers who do not wish to invest in extracting equipment can produce, without further processing, a class of honey in which portions of comb will be eaten.

Special types of lighter weight comb foundation are used to produce cut comb, chunk, or comb honey sections (see *Producing and Marketing Honey*). Since the foundation is intended to be eaten, it is pressed very thin. The beekeeper should remember that replacing the foundation each time the combs are filled increases the cost of producing comb honey. Recovering the cost of the foundation when the honey is sold is justifiable.

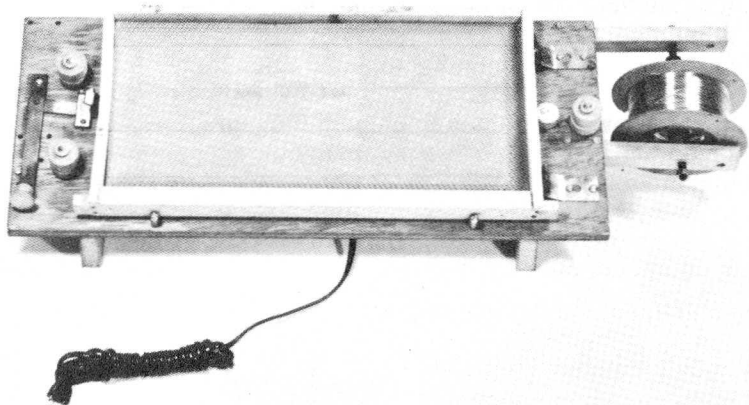


Fig. 4 A wiring jig is used to fasten taut horizontal wires to frames and to embed the wires into sheets of beeswax foundation.

Paint. Hives should be protected from the elements with an ample coating of a good grade outdoor oil, latex, or aluminum-based paint. Paint all surfaces of bottom boards, but only the outside surfaces of boxes and covers. A hive stand (fig. 3) will prolong by many years the useful life of bottom boards. Painting hives different pastel colors significantly reduces the tendency of bees to drift from one colony to another.

Queen excluder. This metal or plastic screen is designed with 0.163-inch spaces to prevent passage of a queen (and drones), while allowing worker bees to pass through (fig. 2A). Usually, a queen excluder is placed between the upper hive body and lower super to keep the queen out of the honey storage area. Queen excluders often become clogged with wax, propolis, or drones that can interfere significantly with passage of worker bees to and from the honey storage area.

L-shaped metal rabbets. These strips of lightweight metal are fastened along the edges upon which the frames rest in each box. The metal surface protects the wooden rabbets from damage by the hive tool when frames are being pried from the hive or when propolis and wax are being scraped from the ledges.

Honey extractor. Honey extracting equipment and procedures are described in detail in the section on *Producing and Marketing Honey*.

Personal equipment ***(fig. 2 D, F, H)***

Smoker. This combustion chamber with attached bellows is used to smoke the colony. Smoke puffed into a hive interferes with the chemical

alarm system used by bees to alert each other of foreign intruders. Judicious use of cool smoke generated from smoldering burlap sacking, wood chips, or other slowly combustible materials, enables beekeepers to examine their bees with little chance of being stung. Oversmoking bees can cause as much agitation as not smoking them at all.

Hive tool. This tool is specifically designed for prying apart boxes, loosening frames, scraping excess wax, and so forth. The hive tool is essential when manipulating hives because bees collect propolis and use it to seal all cracks between the top box and cover, adjoining boxes, and frames and boxes.

Bee veil. Wire veils commonly are used because they do not blow against the face. Meshed tulle veiling is available in various styles, also. Veils are worn over wide-rimmed helmets and usually have strings to keep them tied to the body. Zipper styles are available for use with matching coveralls.

Gloves. Experienced beekeepers seldom use gloves because their use tends to make handling of frames awkward. However, a pair of kid leather beekeeper's gloves definitely is handy for an amateur working with agitated bees.

Coveralls. White, full-length, zippered cotton coveralls are used by many beekeepers to keep propolis, honey, wax, and smoker exudates from soiling their regular clothes. Additionally, the long pants are tucked into boots and the long sleeves are covered by glove gauntlets to keep the beekeeper nearly stingproof. Avoid wearing dark-colored or fuzzy, heavy-woven fabrics, which seem to stimulate stinging.

Managing Bees

Conscientious beekeepers examine their colonies every 10 days or so from the period of rapid spring population buildup until the beginning of the honey flow, again after each honey flow, and when preparing for winter. Attention must be focused on different concerns during the year, but the basic procedures are the same. The smoker should be lighted and burning well, bee veil and other protective apparel should be in place, and hive tool should be in hand before approaching the hive. It is best not to stand in front of the hive while "working the bees," because it will obstruct returning foragers.

Colony examinations

Smoke the entrance and any holes to the outside, and wait for the smoke to move through the hive's ventilation system. With the hive tool crack the cover and puff a little smoke beneath it. Remove the cover and place it on the ground, to act as a stand for boxes that may be removed from the hive. Carefully remove the outermost frame from the nearest side of the hive body and check it quickly for the queen. The queen usually is not on this frame,

but check anyway before setting it down. Very gently stand the frame on edge on the ground, leaning it against a shaded side of the hive. The space created by the missing frame should be adequate to allow the other frames to be pried loose, examined, and replaced out of position in the empty space, until all frames of interest have been examined. During these procedures, glance at the top bars of the frames in the hives to see whether many bees have lined up. If they have, it is time to use a little puff of smoke to send them back down inside. When the inspection is completed, the displaced frames are returned to their original positions, the removed frame is replaced, and the hive is closed. Examinations conducted on warm, calm, sunny days interfere very little with colony functions and are met with little resistance.

Beekeepers should assess critically the following points when they examine a colony:

- (1) **Good queen.** This is based on a solid, good-sized brood pattern and/or presence of eggs. There is no reason to find the queen unless the beekeeper intends to requeen.
- (2) **Adequate stores of food.** The bees should have a minimum of four

deep frames (filled on both sides) of honey or sugar syrup and the equivalent of one full frame of pollen available to them. Generally, there is more honey, which is essential for overwintering.

(3) **Freedom from disease.** Brood diseases cause discoloration of larvae, or patchy brood with scattered cappings (see *Bee Diseases*).

(4) **Properly arranged hive.** The brood should be kept in the lower hive bodies with empty combs moved to the proper location to allow upward expansion of the brood nest. There should be adequate space above the brood nest for storage of large volumes of nectar

and honey if bees are kept in areas with potentially heavy honey flows.

Spring management

An overwintering colony should consist of enough bees to cover at least five frames. If there are fewer, the beekeeper may suspect problems with the queen, disease, or poor late summer and fall pollen supplies, which can commonly occur in California. There should be at least four frames of honey or syrup and adequate space for brood rearing and storage of nectar. Very weak or queenless colonies may be united with more populous colonies.

PREVENTING SWARMING

Swarming is the natural means of colony reproduction. Colonies with an adequate population size rear new queen cells (Plate I), slim down the laying queen, and eventually about half the bees and the old queen leave to seek a new hive and start a new colony. Swarming usually coincides with relatively good foraging periods and tends to occur from late March to July, with a peak in mid-April in the Davis area. Late summer swarming can also be a problem.

Beekeepers who desire maximum productivity from their bees cannot afford to allow half the bees to fly away with a concurrent break in brood rearing of up to 2 weeks. A number of steps may be taken to reduce the chances of swarming, but routine inspections at 10-day intervals and destruction of every queen cell are the only methods by which swarming reliably can be prevented.

Swarming generally is linked to colony congestion. Congestion can be relieved by:

(1) **Reversing boxes.** Bees tend to move their brood nest up to the top of the hive. When young brood fill most of the top box of the brood chamber, put that box on the bottom and allow the bees to move up through other, less filled boxes.

(Consult a textbook for procedures.)

Following the early spring blooming period, a colony should have six or more frames covered with bees in a ten-frame, one-story hive. In a two-story hive, there should be 12 frames covered with bees with brood on both sides of four to five frames (200 to 400 square inches). Under these conditions, brood rearing will increase rapidly, and the colony will build up to a maximum population for the beginning of the major honey flow.

Only a few days of abundant spring nectar flows are needed to crowd the brood-rearing chamber of a one-story hive with honey and pollen, so a super with frames of empty

combs should be added to the hive when the flow begins. Frames with foundation should be provided only when the bees are gathering an abundant supply of nectar. Worker bees reluctantly will draw out a super of foundation placed directly above the brood. Inserting a frame of foundation at the edge of an expanding brood nest usually assures acceptance of the comb.

Brood rearing puts a heavy demand upon the food supply. It is important to keep a close check on all colonies during March, April, and May in northern California and as early as December, January, and February, in southern California south of the Tehachapi Mountains.

(2) **Adding boxes.** Bees will move into new boxes to clean the combs, draw foundation, or manipulate honey, thus relieving congestion in the brood chamber.

(3) **Dividing colonies.** When colonies have eight to ten frames of brood, they can be divided into two colonies. It is best to have a young, mated queen ready for the queenless half. (The Demaree method is similar, but division is uneven and both colonies are kept, one above the other, in the same hive. See text books for a full explanation.)

(4) **Using young queens.** First-year queens are much less apt to swarm, while second-year queens and queens from captured swarms are very likely to leave. Clipped (wings) queens are not able to fly; however, this does not preclude swarming. The queen will walk out of the hive, get lost on the ground, and the swarm is very apt to leave later with a virgin queen, leaving the original colony hopelessly queenless. Despite all advertising to the contrary, no special devices meant to be placed in or on the hives can adequately prevent swarming.

If a colony is preparing to swarm, there will be a number of queen cells on the combs. To requeen, select a well-developed queen cell and remove all others. Also find the old queen and kill her by pinching her head. The new queen will emerge from her cell in a few days and thus requeen the colony (unless it swarms!).

Good spring pastures often prove to be inadequate sources of pollen and nectar in summer. Feeding bees both syrup and pollen is essential in some locations for continued brood rearing, maintaining bee populations, insuring adequate winter stores, and successful overwintering. Commercial beekeepers move their hives hundreds of miles to locate their bees in areas with ample forage. Knowledge of the annual blooming sequence and locations of good forage plants is essential for economically successful moves. It is also important to provide adequate space for incoming nectar. Excess open combs have been shown to increase honey production; inadequate space leads to honey in the brood nest, which hampers brood production and leads to population decline.

Extracted honey may be harvested as soon as the combs are full of honey and are three-fourths capped in regions with low relative humidities. Honey should be fully capped and processed quickly in areas with high relative humidities. Equipment and techniques for handling honey are explained in *Producing and Marketing Honey*.

Summer management

Because spring pastures are often inadequate for summer foraging, enough inspections should be made in summer to ascertain whether there is sufficient natural food in the hives; at least 30 pounds of honey should be in each hive all summer. (When inspecting hives, also check for disease.)

PREVENTING ROBBERING

A few bees probably rob some honey from other colonies most of the time, but during nectar dearths robbing can become severe and colonies can be destroyed. Robbing bees usually can be recognized by their "dangling feet" flight at the hive entrance and by their attempts to enter cracks between supers.

Taking the following steps will help minimize robbing:

- (1) When examining colonies during dearth periods, do not keep hives open any longer than is absolutely necessary and place frames of honey in a super covered with wet burlap during inspections.
- (2) If feeding is necessary, start feeding in late afternoon. When bees are fed in the morning, the excitement can trigger robbing behavior.
- (3) Colonies are best protected by a robber screen (fig. 5), which reduces the entrance considerably while allowing adequate ventilation on hot days.

Fall and winter management

If they are going to build up quickly the next spring, colonies should go into winter with large, well-fed populations of young fat bees. In many locations in California there is not enough pollen to sustain adequate brood rearing through August and September and colonies should be fed pollen, pollen supplement, or a substitute. (See *Feeding Bees*.) An ideal colony for wintering contains a vigorous young queen, is disease-free, has 10 or more frames covered with bees, and has an adequate supply of stored food. Queenless colonies, or those very sparsely populated, should be united with stronger, queenright colonies. Colonies with less than 10 frames of bees can be overwintered, but they should be forced into a single hive body beneath a super of honey.

The colony actually begins consuming winter stores after the final major honey flow and continues until the spring flows start in earnest many months later. Even in areas where brood is reared year-round and bees attempt to find food daily,

honey often is consumed faster than it is produced. A prudent beekeeper should start the winter with 50 pounds (one completely full, full-depth super) of honey or syrup on the bees. Colonies with this amount of food usually will not require winter feeding and will do well during a rainy spring.

"Robbing," an activity evident in apiaries during the absence of a nectar flow, can lead to the destruction of colonies. (See section on robbing.)

As temperatures cool, entrances can be reduced to a couple of inches, but check during winter that entrances have not become clogged with dead bees. Precautions should be taken to fasten covers to the hives and to turn entrances away from prevailing winter winds.

Winter is the slowest season for bees and beekeepers, although winter feeding of bees is common in California. This is the time to prepare equipment, paint hives, and renew supplies of materials to be used the next season. Once February arrives in California, the new beekeeping season begins.

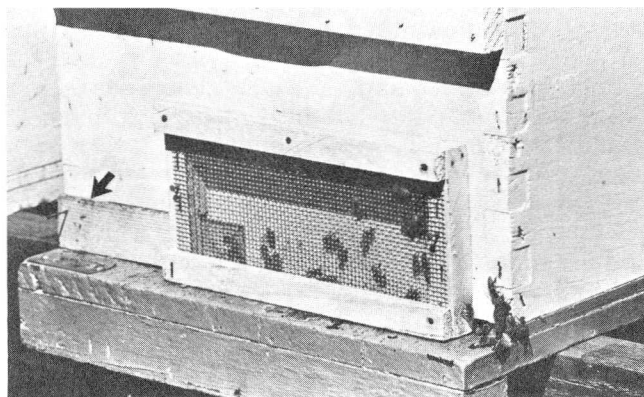


Fig. 5 A robber screen reduces the size of the entrance, which must be protected against robbing bees, while providing a means for hive ventilation.

Feeding Bees

Honey, pollen, and water comprise the natural diet of honey bees. Honey is their carbohydrate/energy source. Pollen provides protein, fats, vitamins, and minerals to the nurse bees, essential for producing the royal jelly that is fed to the queen, drones, and young larvae. Royal jelly is fed in overabundance to larval queens. Worker bees consume a frame of honey and pollen for each frame of brood they rear. A colony rearing 1,000 new bees a day requires nearly 10 pounds of pollen and nectar a month. Simply to survive, various estimates suggest, a colony requires approximately 100 pounds of honey and 50 pounds of pollen each year. Water, the major component of bee tissues, is required to dilute concentrated foods, maintain humidity in the brood nest, and air-condition the hive on hot days.

Beekeepers must examine their colonies frequently to assess the condition of the food supply. During periods of nectar or pollen dearth, the beekeeper must supply substitutes, if continued brood rearing is desired. Supplemental feeding is also used to build up populations:

- (1) to compensate in part for pesticide losses,
- (2) for winter,

- (3) for pollination of almonds, and
- (4) for shaking bulk bees for packages.

Instructions for formulating and dispensing various types of feeds to bees follow.

Care should be taken to feed pollen trapped only from colonies known to be free of chalkbrood and American foulbrood disease.

Although bees can be induced to rear brood year-round by continually supplying combs with pollen packed into the cells immediately adjacent to the larvae on the next frame, pollen is usually fed to bees as patties during a season of normal brood production. Pollen pellets can be mixed directly into sugar syrups (after being soaked in water for a few minutes) and mixed until a smooth, heavy paste is formed. The mixture should be allowed to sit for 24 hours before feeding to be sure that it has not become too dry, since pollen absorbs quite a bit of the moisture from the syrup. The mixture should be dry enough to prevent oozing between the frames, but moist enough so that the bees can chew it. The $\frac{1}{2}$ - to $1\frac{1}{2}$ -pound patties are placed in the hive on top of the frames, in direct contact with the cluster of bees.

Supplemental Feeding—Pollen

Product	Major components	Comments
Air-dried pollen products	Extremely varied: moisture—25%; protein—6 to 40%.	Acceptable to bees if air-dried, then frozen; stores well frozen; mixed pollens better than single source. Soften pellets with water before feeding as paste or mixing into pollen supplement. Has proven ability to spread chalkbrood if trapped from infected colony; can possibly be contaminated by pesticides.

Supplemental Feeding—Sugar

Product	Major components	Type of feeder	Comments
Honey			
comb	fructose (38%) + glucose (31%) + sucrose (1%) + other sugars (9%) + water (18%)	None	Requires availability of water to be utilized; proven ability to spread American foulbrood (AFB) when taken from a contaminated hive.
extracted		Same as light sugar syrup	Usually diluted by one-fourth or one-half with water. Ferments rapidly; feed only the amount that will be removed from feeder within 48 hours.
Sugar			
granulated	sucrose	None	1 to 2 lb poured toward back of bottom board only to prevent starvation; requires availability of water to be utilized. Not recommended.
confectioner's (powdered)	sucrose + 3% corn-starch	None	Used for diluting antibiotic mixes; can be made into syrup.
Baker's Drivert (powdered)	sucrose + 4% glucose and fructose	None	Very attractive as dry feed; used for diluting antibiotic mixes; used in dry pollen supplements or substitutes; used in production of queen cage candy.
Syrups			
light	1 sucrose: 1 water	Friction top can (or bottle) through hole in cover best; frame-type feeder with footholds; bottle at entrance least effective	Stimulates oviposition, encourages brood rearing, ensures drawing combs from foundation. Used during nectar dearths or to increase colony populations; used in pollen supplements and substitutes.
heavy	2 sucrose: 1 water or 2½ sucrose: 1 water + 1 tsp cream of tartar/20 lb sugar—boiled	Same as light syrup	Fed in late fall, to be manipulated and stored as winter feed when honey is short.
Type 50	sucrose (38½%) + glucose (19¼%) + fructose (19¼%) + water (23%)—acid inverted	Same as light syrup	Delivered as 77% solids and does not ferment or crystalize out of solution; very attractive bee food full strength or diluted any time of year; used in pollen supplements and substitutes; available only by tank truckloads.

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Supplemental Feeding—Sugar (continued)

Product	Major components	Type of feeder	Comments
Liquidose 50	sucrose (38½%) + glucose (20%) + fructose (16%) + other sugars (2½%) + water (23%)—inverts from high fructose corn syrup	Same as light syrup	Delivered as 77% solids and does not ferment; will crystallize out of solution below 80°F; very attractive full strength or diluted; used in pollen supplements and substitutes; available in tank truckloads, drums, or 5-gallon pails.
Nulomoline	50 to 90% inverted sucrose + glucose crystals or micropulverized sucrose + water + invertase	None	Very heavy syrup used in preparing queen cage candy.
queen cage candy	Nulomoline + a little Drivert + a couple drops of glycerine kneaded to proper consistency	None	Let stand overnight and check consistency before use; reconstitute if hard and dry or soft and sticky; stores for long periods in airtight containers.
Corn syrup			
high fructose corn syrup (HFCS)	fructose (26%) + glucose (31%) + other sugars (5%) + water (38%)—acid hydration of cornstarch to glucose; enzyme conversion of glucose to fructose	Same as light syrup	Available in various percent solids; no detrimental effects on free-flying bees; may become major bee food if sugar prices increase significantly.

Supplemental Feeding—Pollen Supplements and Substitutes

Product	Major components	Comments
Pollen supplement	pollen (5 to 25%) + pollen substitute	Used similarly to pollen substitutes, but added pollen makes mixture more attractive to bees and may be superior nutritionally.
Pollen substitutes	<p>Dry ingredients:</p> <p>a) brewer's yeast</p> <p>b) Torula yeast</p> <p>c) Torutein-10</p> <p>d) lactalbumin; or mixtures of these</p> <p>Moist ingredients:</p> <p>a) light syrup</p> <p>b) diluted honey</p> <p>c) Type 50 syrup</p> <p>d) Drivert syrup</p>	<p>Maintain brood rearing in colonies during periods of pollen dearths. (Do not stop feeding until pollens become available.) Inclusion of some sort of yeast supplies substantial vitamins.</p> <p>Can be fed dry, but are consumed better as moist patties on the top bars of frames containing brood. Formulated to consistency of thick paste. Should not harden or run down between combs (partially inverted sugars or honey maintain consistency best); consumed rapidly only when bees are rearing brood in absence of pollen; diluted honey can spread AFB if produced in a contaminated hive.</p>
Products to avoid:		
untoasted soyflour		Destroys bees' digestive enzymes.
salt		Only use ingredients with < 2% salt content.