



THE BEEKEEPER'S HANDBOOK

FOURTH
EDITION

DIANA SAMMATARO *and* ALPHONSE AVITABILE

Foreword by DEWEY M. CARON



READING SAMPLE

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Obtaining and Preparing for Bees

Whether you are about to become a beekeeper, or are a novice or an established apiarist, there are a number of options available for obtaining your first bees and/or augmenting the number of colonies you wish to maintain.

- Buy package bees.
- Buy or produce your own nucleus colony or established colonies.
- Retrieve colonies nesting in natural or man-made cavities or bait boxes.
- Collect bees that have started building exposed combs.
- Collect swarms.

BUY PACKAGES

Package bees come primarily from the southern states, Hawaii, and California and are shipped in the spring by mail or are picked up by dealers and trucked to their final destination. To order packages, look for advertisements in the bee journals (such as the *American Bee Journal* and *Bee Culture*). Most bee organizations also have a website or a state newsletter with local ads. Bee supply dealers and searches on the Internet will provide the names of other package producers as well.

Call several dealers to compare prices and delivery dates and order packages early in the winter months (December and January) to obtain the desired number of packages and choice of shipping dates. Request early delivery of your packages (e.g., three to four weeks before the dandelions and fruit trees bloom in

your area) to ensure that bees will have enough time to develop. All necessary bee equipment should be ordered and fully assembled well in advance of the arrival dates of your packages. For more complete information on packages, see Chapter 6.

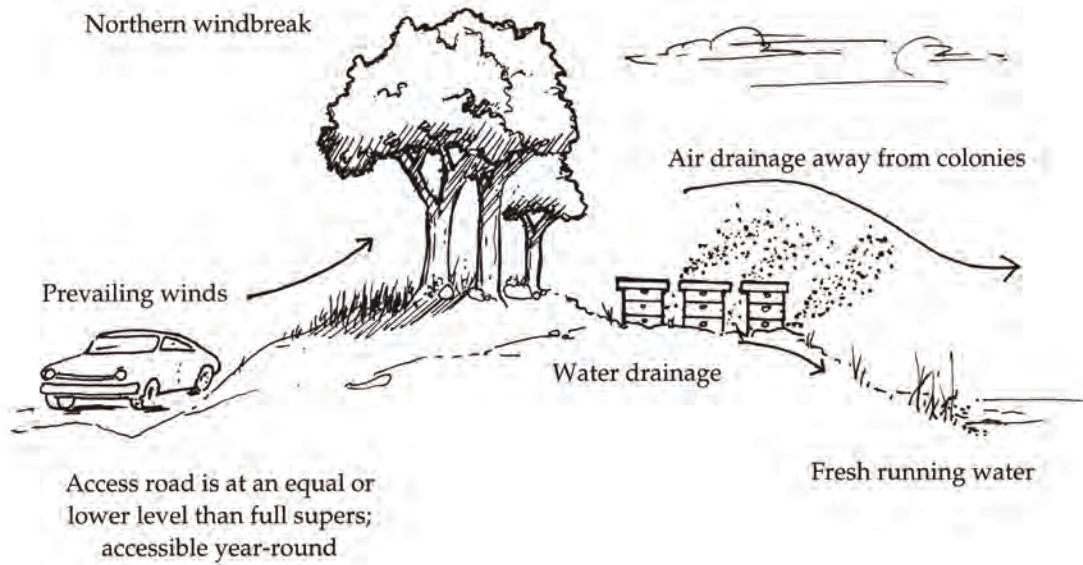
You can also contact local dealers or beekeepers within your state that purchase packages and queens for resale. Local dealers are usually experienced beekeepers who sell not only packages but also nucleus colonies, established hives, and an assortment of bee equipment. By attending meetings of your state or regional beekeeping organizations, you will meet dealers from your area as well as other beekeepers.

Generally, a 3-pound package of bees (about 1.4 kg) plus a mated queen will provide an ample number of bees needed to begin a good colony. The approximate cost of such a package in 2010 with one laying queen was \$80 to \$100 or more. Prices are subject to change and will reflect current conditions.

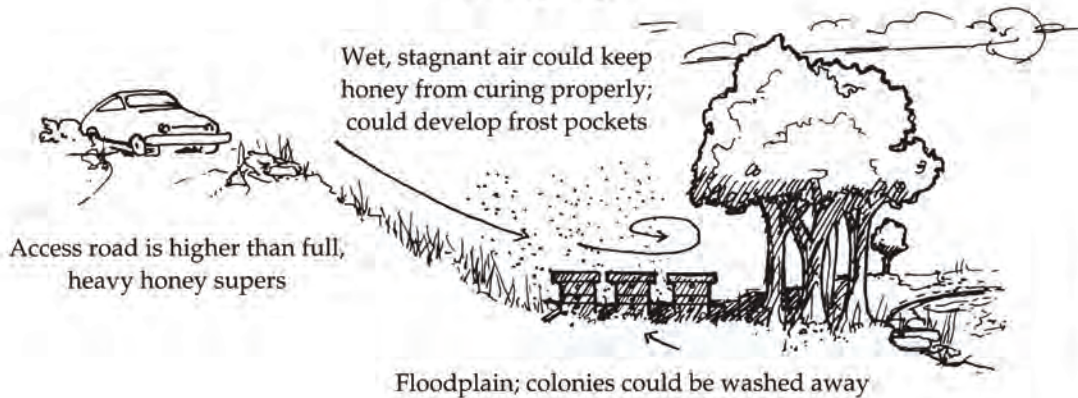
Advantages

- Easier for beginners to work (fewer bees than in an established hive).
- More adult bees than in a nucleus colony.
- Certified as apparently healthy (and mite-free) and from healthy stock.
- No brood diseases.
- Easy to obtain replacement queens.
- Available in 2-, 3-, 4-, and 5-pound units (there are approximately 3500 bees per pound) with or without queens.

Ideal Apiary Site



Poor Apiary Site



Drawing by J. Propst

tion with appropriate town, city, and state agencies. Check your state's agriculture department.

Choose a site to optimize these conditions (see the illustration of ideal and poor apiary sites on this page):

- Close to freshwater—a stream, pond, or lake or a faucet or other device. In the absence of such sources, water must be provided; otherwise, the likelihood of bees visiting neighboring swimming pools, birdbaths, etc., becomes a reality. (Bees appear to be more attracted to *saltwater* swimming pools.) Such visits will annoy your

neighbors and often lead them to seek some relief.

- Easy, year-round vehicle access, which is at or lower than supers, to avoid carrying heavy supers uphill.
- Near dependable nectar and pollen sources (within a 2-mile [3.2 km] radius).
- On upper sides of slopes to improve air drainage away from hives.
- Along the edges of open fields.
- With a northern windbreak for winter protection and noontime summer shade to keep hives cool.
- Near owner or neighbors (with clear commit-

whether to first remove all supers above the bottom ones (to inspect the broodnest) or whether to work from the top down (to see if nectar or honey is being collected). Most of the time you will want to inspect the broodnest, which is where the queen, eggs, brood, drone larvae, and queen cells are; therefore, start at the bottom-most super first, and move upward in the stack.

Step 11. Each time a super is pried off, puff a bit of smoke onto the super below and to the bottom of the one you are moving.

Step 12. If the hive is very populous, it is best to start by examining the bottom-most hive body, after stacking all other supers on the upturned cover nearby (give them an occasional puff of smoke as you work). If you were to begin by working at the top, many of the bees smoked from successive operations on the upper supers will crowd to the lowest super, making it very full by the time you reach it and making it almost impossible to find the queen.

Examining Frames

Now you have made it to the brood chamber hive body, where you want to start examining the bees. Here's how you should proceed:

Step 1. Whenever you decide to begin your examination, smoke the bees off the top bars and down between the frames. Before removing frames, choose the one closest to the hive wall and push all other frames away from it with the hive tool; this will create sufficient space for easy removal of the frame. Avoid removing frames from the center of the hive first, as the queen may be crushed in the process of pulling out the frame.

Step 2. Once the first frame is removed, you have created more space to remove subsequent frames. Lean the removed frame against the bottom hive body or some other object, out of the sun and where it won't be kicked or jarred, or place it in an empty hive body.

Step 3. As each frame is examined, hold it vertically over the hive; in this way, if the queen falls from the frame, she may drop back into the hive.

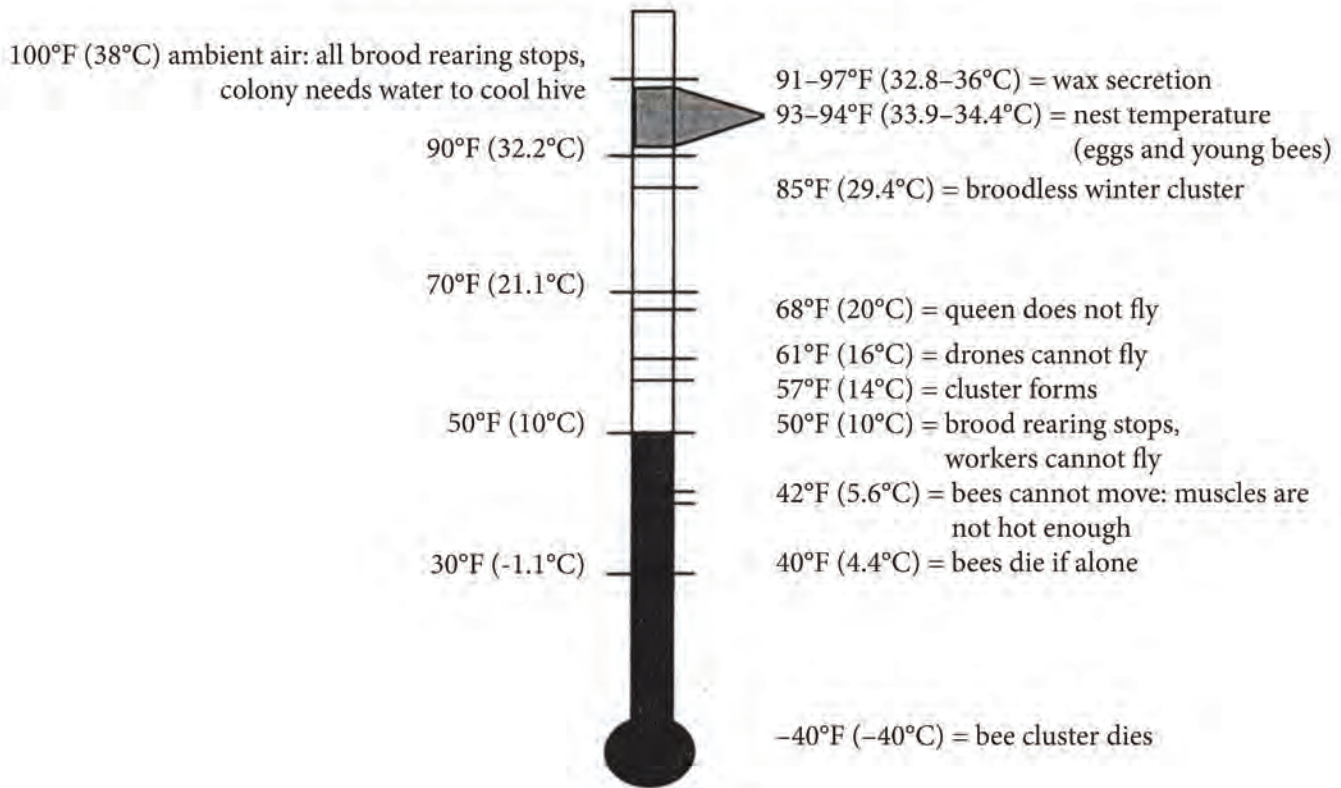
Step 4. Continue to examine each adjacent frame until your objective is completed.

Reading the Frames

For each frame you inspect, quickly check for these items:

1. **Sealed brood:** It should be compact, in a concentric semicircle at the bottom half of the frame. If there are many open cells, it may mean that the queen's eggs were not viable and/or the larvae were pulled out.
2. **Ratio of eggs to open larvae to capped pupae:** A ratio of approximately 1:2:4 is ideal. This means there are twice as many larvae and four times as many capped pupae as there are eggs. It indicates that the queen is laying continuously and the bees are of sufficient numbers to incubate the eggs.
3. **No eggs found:** If no eggs are found in the open cells, you can estimate how long ago the queen stopped laying by opening up some capped worker brood. Young pupae with white eyes will emerge in about seven days; if the eyes are purple, they will hatch in two to three days.
4. **Queen cells:** If you find superseded cells, the queen is failing for some reason. If you find queen cells with larvae, lots of drones, sealed brood, but no eggs, the colony may swarm in about a week. If you find sealed swarm cells, some with holes in them, sealed brood, and few bees in the honey supers, the colony swarmed and a virgin queen is emerged. You should see eggs in about a week.
5. **Other observations:** Note any changes in the behavior of a colony since your last visit, especially if the bees are more volatile; this could indicate lack of forage, pesticide use, pests, mites, queenlessness, or disease. Observe the amount of incoming honey and pollen in case bees are starving (no honey, dead brood on bottom board) or are becoming honeybound (honey filling all available space, even into the brood combs). Also note the physical condition of the combs and frames, including any wax moth damage and uneven comb or foundation; fix any broken frames.

Temperatures at Which Different Bee Activities Take Place



- Unite weak, but healthy hives. Kill all diseased colonies (or those heavily infested with mites); take your losses in the fall; note this in your hive diary.
- Place weights (rocks, bricks, or blocks) on top of hives so the covers will not blow off. Such weights are very important and could save your colonies from dying of exposure. You may also strap the tops onto the hive bodies with plastic webbing or metal straps.
- Remove all bee escapes, queen excluders, and escape boards.
- Leave ample honey (or cured sugar syrup) and pollen stores. Feed syrup early, while the days are still warm, to allow bees to cure such stores; allow about a month for the syrup to cure properly.

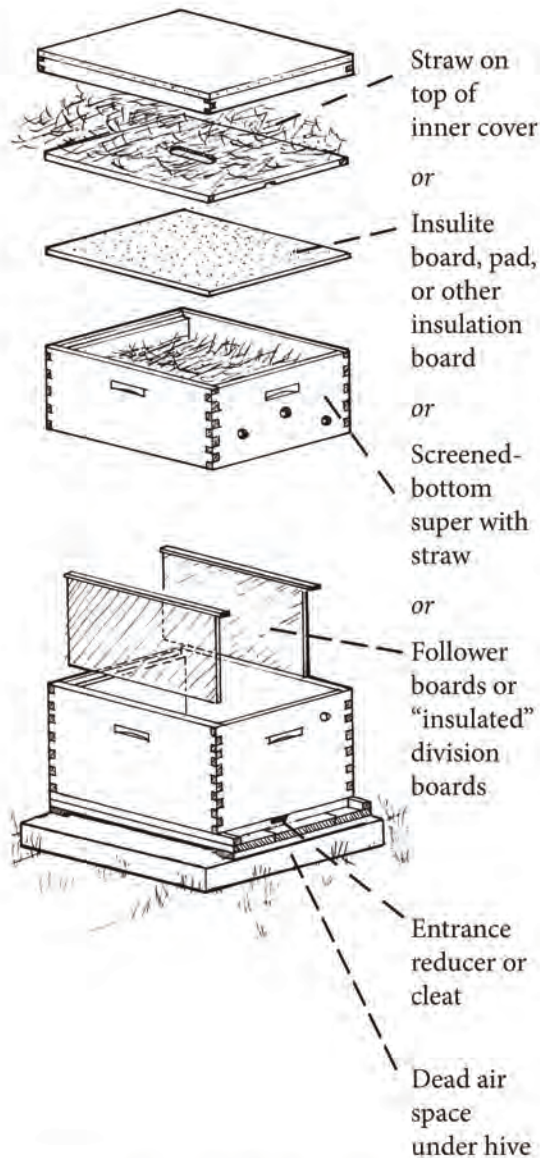
The Winter Cluster

In the late fall and winter, bees form a winter cluster. Honey bees do not “hibernate” but instead form a well-defined ball or cluster when the air tempera-

tures are below 57°F (14°C). On days or weeks when the air temperatures are 43° to 46°F (6–8°C), most of the bees have joined the cluster. The winter cluster expands and contracts as the outside temperatures rise and fall. Bees remain relatively active in the cluster, eating, moving about, rearing brood, and generating heat by “shivering” (contracting their wing muscles). The by-product of these activities is metabolic water vapor, which must be allowed to escape. Ventilation during the cold months is as important as during the warmer months.

The amount of heat generated by the cluster depends, among other things, on whether brood is present. In the late fall, the colony is usually without brood, and therefore, the cluster will be producing only enough heat to keep the colony from freezing, maintaining a temperature of around 57° to 85°F (14–29°C). When the queen resumes her egg laying in midwinter, the cluster temperature in the vicinity of the eggs and brood will be maintained at around 93°F (34°C); see the illustration of the winter cluster on p. 98.

Types of Insulation



cover; remember to cut a hole in the center to let out moist air.

- Place an empty hive body with a screened or cloth-covered bottom on top of the inner cover and filled with insulating material.

Some beekeepers paint hive bodies with insulating paint or put a super of dry, drawn comb on top of the inner cover, although these combs can collect excess moisture and be damaged. Supers of honey are also good insulators, so leaving extra honey on never hurts.

Check how other beekeepers in your area winter

their colonies. If you do nothing else, protect them from piercing winter winds.

PREPARING FOR THE NEXT SEASON

The following tasks should be attended to during the winter months in preparation for the next spring season:

- Order packages to arrive before fruit trees bloom in your location.
- Clean stored supers and frames of burr comb and propolis; replace old combs.
- Build new equipment for the coming year: frames, hive bodies, tops, and bottoms.
- Paint and repair equipment; replace with new equipment if necessary.
- Sort and cut out sagging, diseased, damaged, or drone combs and replace with foundation. Old wax combs need to be replaced every 3 to 5 years.
- If you use plastic-coated foundation, you may want to scrape off the older cells and let the bees draw out fresh wax.
- Melt down old wax and prepare to sell or make candles.
- Order other equipment you will need for the coming year (gloves, extractors, bottles, new veil).
- Check the apiary periodically for damage from downed trees or limbs, wind, or vandals or other predators.
- Attend bee meetings, read or write for your local bee club's newsletters, and review your hive diary notes.
- Browse new catalogs, bee journals, and web pages; buy a new bee book and read it.

LATE-WINTER MAINTENANCE

There are important tasks that need to be done in the late winter and early spring, weather permitting, before the fruit trees begin to bloom. Some of this work may have to be repeated in late spring and thus may be referred to again in the next section on spring maintenance. But this will give you a heads-up of what you will be doing.

The tasks include:

- Checking for dead colonies; removing or closing

Colony Estimations

Estimating Colony Strength (all European)

- A shallow frame fully covered with bees will hold about 0.25 pound (0.1134 kg) of bees or about 875 individuals.
- A deep frame fully covered holds 0.5 pound (0.2268 kg) of bees or about 1750 individuals.
- There are about 3500 bees per pound (0.4536 kg).
- A sheet of deep wax or plastic foundation 8.5 × 16.75 inches (42.5 × 21.3 cm) equals 3350 cells per side. That is 83.75 cells linearly and 40 cells vertically; the number of cells on both sides is 6700.
- One square inch of comb has 25 cells (5 worker cells per linear inch, 4 drone cells per linear inch).
- Count the number of bees returning to the hive for 1 minute. To estimate the number of bees in the deep frames of a colony, use the following equation: number of bees returning per minute × 30 min × 0.0005. The factor 0.0005 assumes that one deep frame, both sides, contains 2000 bees, or 1 divided by 2000 = 0.0005; the time of 30 minutes assumes the amount of time needed for any one bee to make a return trip.

Estimating Weight of the Colony

- Multiply by the number of frames in the colony.
- A deep frame fully filled with honey weighs about 10 pounds (4.536 kg).
- A full medium frame (U.S.) weighs 7 pounds (3.2 kg).
- A full shallow frame (U.S.) weighs 5 pounds (1.8 kg).

bees from drowning, fill the tank with sand or pebbles. You can also use a dripping hose or install a Boardman feeder filled with water in each hive.

- Use screened bottom boards to give more ventilation.
- Paint metal covers or wooden tops with white paint to reflect the maximum amount of sun.

Signs of Honeyflow

Prepare for a honeyflow in the winter or spring months; do not wait until the last moment to make extra frames or supers or you could lose a honey crop! Start by repairing frames or by making frames with foundation for the honey supers. Keep fresh wax foundation sheets in plastic bags to protect them against wax moth infestation and to keep them from drying, because dry foundation becomes brittle and breaks easily.

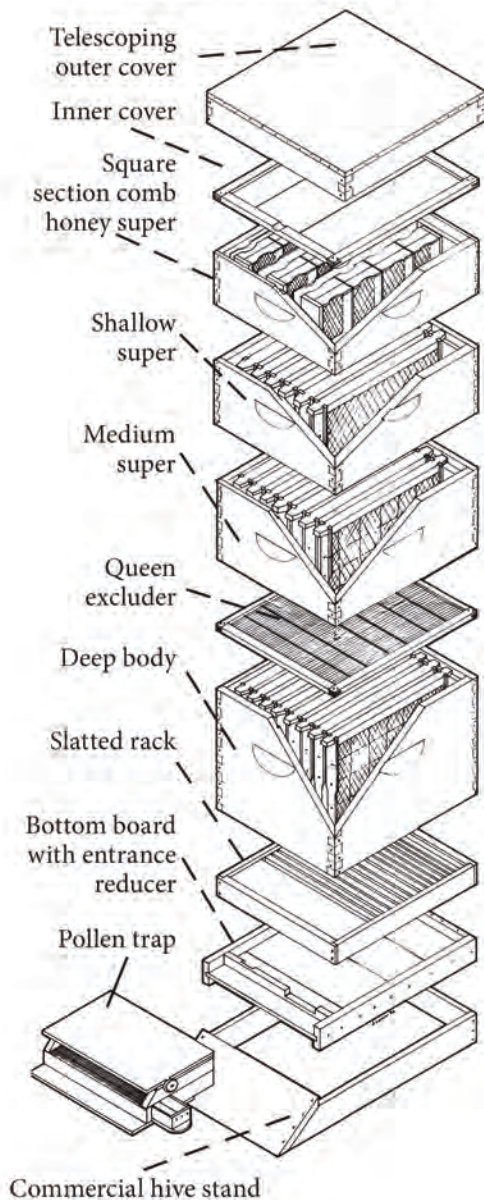
Honeyflow is the time of year when bees are able to collect ample supplies of nectar. A honeyflow may last a few days or a few weeks. Bees are natural hoarders, and the presence of empty combs stimulates this hoarding behavior, so if you provide the bees with more storage space than they need, you will be inducing more bees to collect nectar. This behavior of storing more food than is immediately needed is a sound evolutionary trait, for the amount of food any one colony will need or produce is unpredictable. By understanding this aspect of bee behavior, you increase the opportunity to obtain a surplus (more than the colony needs) of honey. This surplus is stored by the bees as honey in supers (located above the brood chamber). Good beekeepers harvest only this surplus and leave ample food reserves.

A honeyflow is indicated by one or a combination of the following signs:

- Fresh, white wax evident on edges of drawn comb and on top bars.
- Dramatic weight gains (as indicated by the hive scale) over several days or weeks.
- Wax foundation drawn out quickly.
- Large amounts of nectar ripening in cells.
- Bees fanning at hive entrance.
- Much foraging activity.
- Odor of nectar (ripening honey) often pervading the apiary.
- During a honeyflow, bees are extremely docile and easy to work.

During the main honeyflow, you should avoid opening the hive to look at the brood area unless you are doing some major management operations (requeening, treating for diseases, etc.), nor should you place pollen traps on hives. Check the colonies before a major honeyflow, because if you disrupt the bees by

Beehive Components



(when extracted) unsanitary because of the presence of larvae and pupae. The extracting tank will have honey and brood mixed together and brood would be wasted. In addition, it is difficult to cut away the cappings of brood combs that have been darkened with propolis. Cull any dark and old frames and save them for other uses, such as bait for swarm traps; otherwise, melt them down for wax.

Use one of the following methods to restrict the queen from laying in the honey supers:

- Place a queen excluder above the broodnest (see the illustration of beehive components on this page).

- Place a super of light-colored comb or foundation above the broodnest; as long as the queen is not crowded for space, she will prefer to lay her eggs in the darker comb.
- Keep a hive body filled with honey directly above the broodnest. Such a honey barrier often keeps the queen from moving upward.
- Place a section comb honey super above the broodnest; the queen generally will not lay in the section boxes or other types of comb honey sections.

Some general guidelines for supering bees during a honeyflow are listed below:

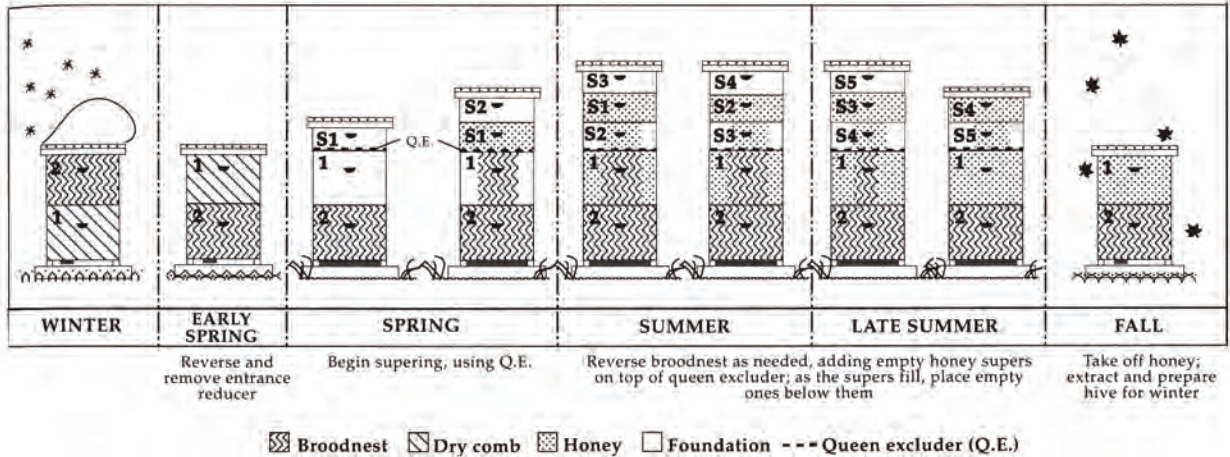
- Stagger the honey supers to hasten the ripening of honey, leaving a 1/4-inch gap, especially in hot, humid areas (but do this only on very strong colonies to avoid robbing by robber bees); you can also use a screened bottom board instead.
- Use only eight or nine frames in the supers destined to be extracted, so the bees will draw cells out wider than normal; this makes it easier to cut the cappings off when extracting honey.
- Bait an empty honey super with a frame or two of capped or uncapped honey if the bees seem reluctant to move up; this will attract bees to move into the super.
- Some beekeepers use drone comb foundation in their honey supers; the cells are larger and honey seems to extract readily from them. Drone foundation can be obtained from bee supply houses.
- Rearrange frames in supers periodically, so the full ones are at the ends and the empty ones are in the middle (bees fill the middle ones first). If you are low on supers, this exchange will give you some time to ready more supers.

Methods of Supering

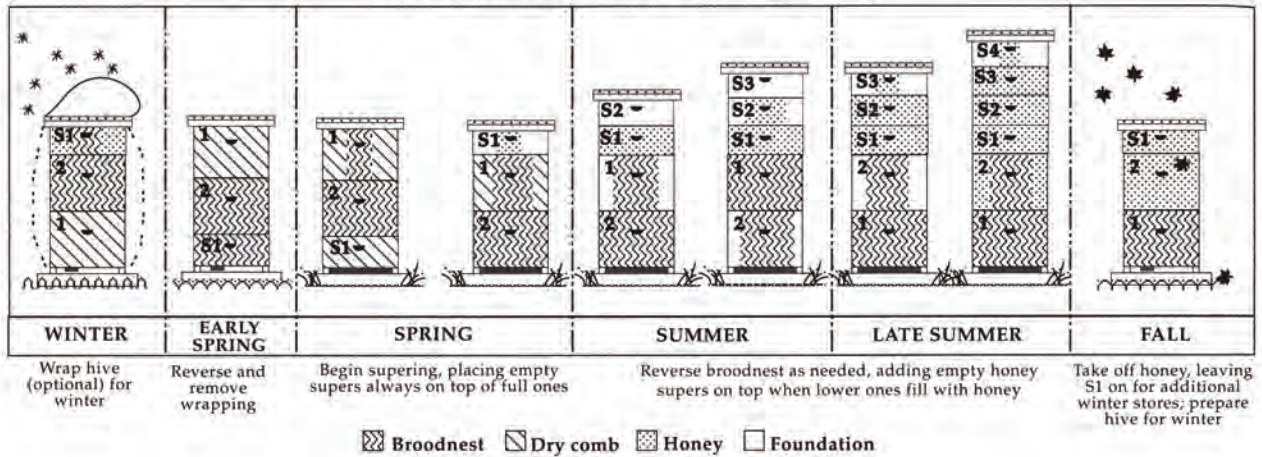
There are two basic ways to super for honey; these are reverse supering and top supering (see the diagram on supering on p. 113).

Reverse or Bottom Supering. This method generally needs a queen excluder to keep the queen from laying in the honey supers (see the diagram on supering on p. 113 and the one on the reverse supering sequence on p. 114) and can also be used for comb honey production. A super with foundation or dry

Reverse Supering Sequence for Extracted Honey



Top Supering Sequence for Extracted Honey



Supering for Section Comb Honey

Comb honey, especially section comb honey, is difficult to produce because success depends on a heavy honeyflow, exceptionally strong colonies, and time-consuming hive manipulations at the correct intervals. The Miller method of supering is one that is used for section comb honey; this is described below and is illustrated as method A in the diagram on p. 115.

A colony used for section comb honey production is generally wintered in two deep hive bodies (1 and 2). In the spring, this colony must be built up to full strength prior to the major honeyflow, and the brood chambers should be reversed to provide ample room for the queen to lay. This may need to be done several times to maintain enough empty comb for the queen to fill with eggs.

As soon as the honeyflow begins, reduce the strong two-story colony to one deep (2). Set up this colony so it contains two empty brood frames (in the middle) and as many frames of capped brood as possible on either side, with accompanying queen and worker bees.

The following is the procedure for method A, without using queen excluders:

- Step 1.* Reduce colony to one deep (2); frames of honey and any remaining brood frames should be given to other, weaker colonies.
- Step 2.* Over the reduced hive (2), place the first section super (ss1), with thin foundation in the section boxes or rounds (or whatever system you use).
- Step 3.* When ss1 is half full of honey, place a second section super (ss2) below it.

can still have your queens delivered in the summer; plan to install them in nucs to get them laying in preparation for fall requeening (by uniting the nuc to the colony; see “Uniting Weak Colonies” in Chapter 11). Order queens as you would packages, as early in the year as possible, because most breeders start making queens when snow is still on the ground in northern states. You can have your queens arrive either in the spring or in the summer. Some breeders will ship queens with or without attendants; others will place the cages in a screened bulk shipping container (especially if you order 10 or more queens at a time) that includes loose worker bees and some kind of food.

Treat your queens carefully and follow the installation instructions given below. It is advised that you **not** treat new queens with miticides until they have been laying eggs for about 30 days.

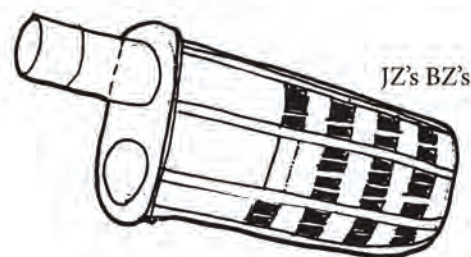
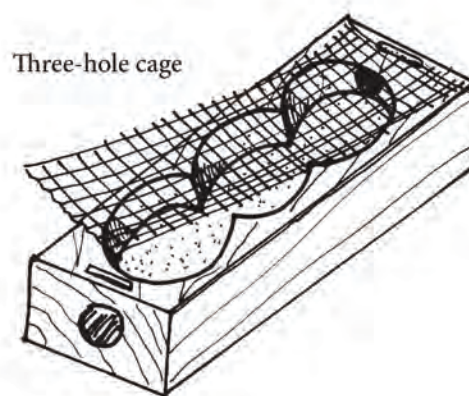
Many journal advertisements market “mite-resistant” queens. Be sure to inquire which mites they are resistant to and what the basis for such claims is. Do your homework, research the claims, and talk to other beekeepers who have used queens from the same providers. To date, the only known bees with some resistance to mites are the hygienic line and hybrids with Russian and SMR (VHS) stock.

Types of Queen Cages

Purchased queens are packaged in queen cages and mailed from breeders to all parts of this country and abroad. Some of the procedures for notifying the postal service of the arrival of bee packages should also be followed when queens have been ordered (e.g., call to alert the post office of your order, as suggested in Chapter 6). Again, all queens must be certified to be free of mites.

In the United States, queen bees are shipped in several kinds of cages. One style is the *Benton* (also called two- or three-hole) mailing cage; it is a small wooden block, approximately $3 \times 1 \times \frac{3}{4}$ inches ($7.5 \times 2.5 \times 2$ cm) with wire screening stapled over the length of it to cover the two or three holes to the compartments (see the illustration of queen cages on this page). Generally, two compartments serve as the living quarters for the queen plus several attendants, and a third compartment contains candy. At either end of the cage is a small, bee-sized hole. The hole at one end is adjacent to the compartment

Queen Cages



that is filled with candy, while the hole at the opposite end is used to place the queen in the cage; both openings are closed with cork plugs upon shipment. The candy serves two purposes: it provides food for the bees inside and delays release of the new queen from the cage into the colony. The hive bees must eat the candy plug before the new queen can be freed. This usually takes about two to three days, by which time the colony will have adjusted to the new queen's scents, improving her acceptance.

Other cages used by bee breeders (see the illustrations) include JZ's BZ's plastic cage and the California Mini Queencage, developed by C.F. Koehnen and Sons. The latter is a narrow wooden block, about $2 \frac{1}{2} \times \frac{3}{4} \times \frac{3}{4}$ inches ($6.5 \times 2 \times 2$ cm), with one long compartment. It has a large candy-filled plastic tube

Indirect Release

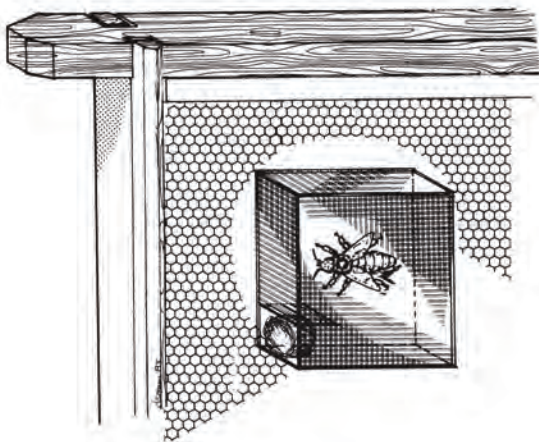
Push-in Cage

The push-in cage is a tried and true method of introducing the queen (see the illustration of the push-in cage on this page), first used in the 1900s. This method is the best one to use, especially if you are introducing an expensive breeder or inseminated queen.

The cage is made by folding all four edges of a square or rectangular piece of hardware cloth at right angles, to form a box with a top and sides but no bottom. The top of the formed box should be at least 3 × 4 inches (8 × 10 cm) and the sides at least ½ inch (1.3 cm) deep (see the illustration). You can also make a bigger one, 5 × 8 inches (12.7 × 20.3 cm). Pinch the corners of the box into a triangle so they will fold cleanly on the edges. Use 1/8-inch (3.2 mm) hardware cloth that has been soaked in hydrogen peroxide and rinsed with water; brand new hardware cloth has toxic substances that will kill bees and queens. Plastic push-in cages are now commercially available, and ads for these cages can be found in the bee journals and online.

Dequeen the colony at least one day (12–24 hours) before installing the new queen. Feed the colony to be requeened with sugar syrup for a few days before you introduce the new queen, and then go in and find and remove or kill the old queen. When you are looking for the queen, use smoke sparingly, as too much smoke will cause the queen to run, making it more difficult to locate her. When you find her, kill or remove her.

After the colony has been dequeened, remove a frame that has capped brood and some honey, and



Push-in Cage

remove all bees from the area to be occupied by the push-in cage by shaking or brushing off the bees. Place the new queen on a patch of capped brood and honey and push the bottom of the cage into the comb over the newly obtained queen.

The comb under the cage should contain capped brood, a few cells of honey, and no adult bees. As bees under the cage emerge, they will care for the queen. After seven days, release the queen by removing the push-in cage. Some beekeepers cut a hole in one of the corners of this cage and plug it with candy made from a small amount of honey mixed with confectioners' (powdered) sugar or a piece of marshmallow (see the illustration); the bees will release the queen after eating through the candy. The disadvantage to this method is that the bees may eat under the cage, by scraping away the comb, and kill the enclosed queen.

Indirect Release with Queen Cage

This method of requeening employs a queen cage; here are the steps to follow:

- Step 1.* Dequeen the colony 12 to 24 hours prior to replacing with new queen.
- Step 2.* Select a caged queen with no attendants.
- Step 3.* Remove the cork in the candy end, and if the candy is hard, use a nail to make a small hole through it to make it easier for the hive bees to free the queen by eating out the candy. The hole should not be too large; one of the purposes of the candy plug is to delay the queen's release and thus enhance her acceptance. Do not make a hole if the candy is soft. Be careful not to impale the queen with the nail!
- Step 4.* Find a frame or two containing uncapped larvae and cut out some of the comb to allow the queen cage to fit vertically from the top bar, screen side out. Push in the cage, candy side up, and place the frame back in the hive. Now place a frame of young brood next to the queen and push the frames together so the bee space is maintained. (If you leave a gap, the bees will fill it with comb because they do not tolerate additional space.) Make sure the hive bees have access to the screened or open side (if plastic) of the cage and to the candy plug and queen. Alternatively, place the cage horizontally between the top bars of two frames of brood, screen side down, so the bees

not strong enough to swarm, and feral colonies, which were once common, have been killed by mite infestations. Sometimes, the bees filling this niche are Africanized bees.

Reasons for Swarming

Honey bee colonies swarm for any one or more of these reasons:

- Congestion.
- Unbalanced numbers of different-aged workers.
- Overheating (perhaps due to lack of noontime shade).
- Defective or old combs (those with too many drone cells or cells that are irregular, thick, damaged, or otherwise not suitable for the queen to lay in, reducing broodnest capacity and increasing congestion).
- Queen's egg laying becoming restricted as empty cells are filled with honey.
- Inclement weather, which keeps bees confined to the hive and causes congestion (bees hanging out of colony).
- Failing queen—instead of superseding the queen, the colony may swarm.
- Decline of queen pheromone production—the level of pheromone being distributed throughout a highly populous colony is insufficient to control swarm preparations.
- Genetics or race of bees.
- Idle nurse bees.

Other Reasons Why Bees Leave

Under certain conditions, the entire original colony may depart its home. This is called *absconding* and could be caused by:

- Disease or mites.
- Starvation.
- Wax moth (or other pest) infestation.
- Fumes from newly painted or otherwise treated hive equipment.
- Poor ventilation.
- Excessive disturbance of the colony by the beekeeper or vandals.
- Excessive disturbance by animal pests such as skunks and bears.

Signs of Swarm Preparation

Signs that a colony is in some stage of swarm preparation are clearly visible during routine hive inspections. The list below presents a rough chronology of the various signs you might see in a colony that may ultimately swarm:

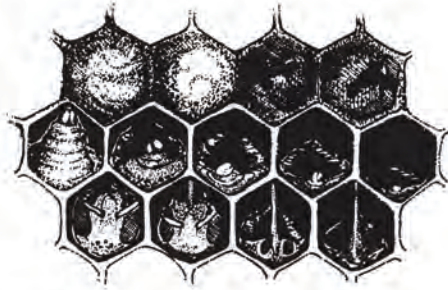
1. Rapid increase in worker population occurs (especially in spring, after a minor honeyflow and before a major honeyflow).
2. Drone rearing begins as worker numbers increase.
3. Broodnest (area where eggs, larvae, and pupae are located) cannot be expanded due to combs already occupied with brood and/or honey.
4. Queen cup construction along the bottom edges of the frame becomes evident.
5. Queen deposits eggs in these queen cups; larvae are present.
6. Queen's egg laying tapers off and amount of young brood decreases.
7. Queen is restless (thinner and has lost weight so she can fly).
8. Many queen cells are present and contain larvae that vary somewhat in age.
9. Field bees are less active and beginning to congregate at hive entrance; this can also happen if weather is hot or colony congested.
10. Swarm cells are capped or sealed.
11. Swarm is cast.

Signs of Imminent Swarm

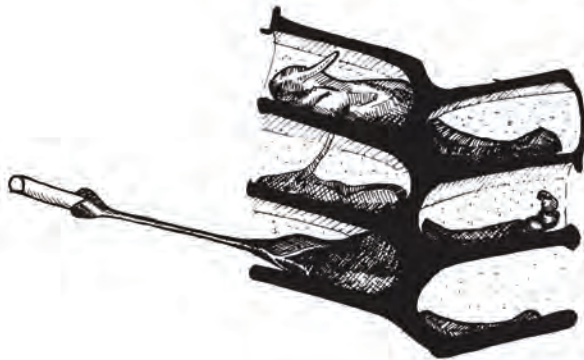
A colony that has been making swarm preparations can be expected to issue a swarm:

- After queen cells (swarm cells) are sealed over.
- When wax has been removed from the tips of queen cells, exposing the cocoon (referred to as a "bald spot").
- When few bees are foraging (little flight activity of bees at hive entrance) compared to other hives of same strength.
- When bees are clustered near the entrance, not due to hive congestion or warm temperatures.
- Usually on the first warm, sunny, calm day following a short period of cold, wet, cloudy days when congestion in the hive is aggravated.

American Foulbrood Disease



Symptoms:
Cappings are sunken, brood appears dark brown and "melted" down, and pupal tongue sticks up



Test:
See if the contents of the cells are sticky and will extend at least an inch when drawn out

Once the vegetative stages appear in a colony, the disease is spread rapidly and the colony weakens; in most cases, the hive will eventually die unless it is resistant to AFB. Spores can live in hive products (honey, wax, and propolis) for up to **80 years!!** It takes about 10 spores fed to a one-day-old larva for it to become infected. More spores are required to infect older larvae. Death of the developing bee occurs after the cell is capped over and not immediately visible. Once AFB has progressed, diseased larvae, partially uncapped by the bees, turn into black, sticky scales, often seen with their pupal tongues stuck out.

AFB is transmitted from hive to hive in these ways:

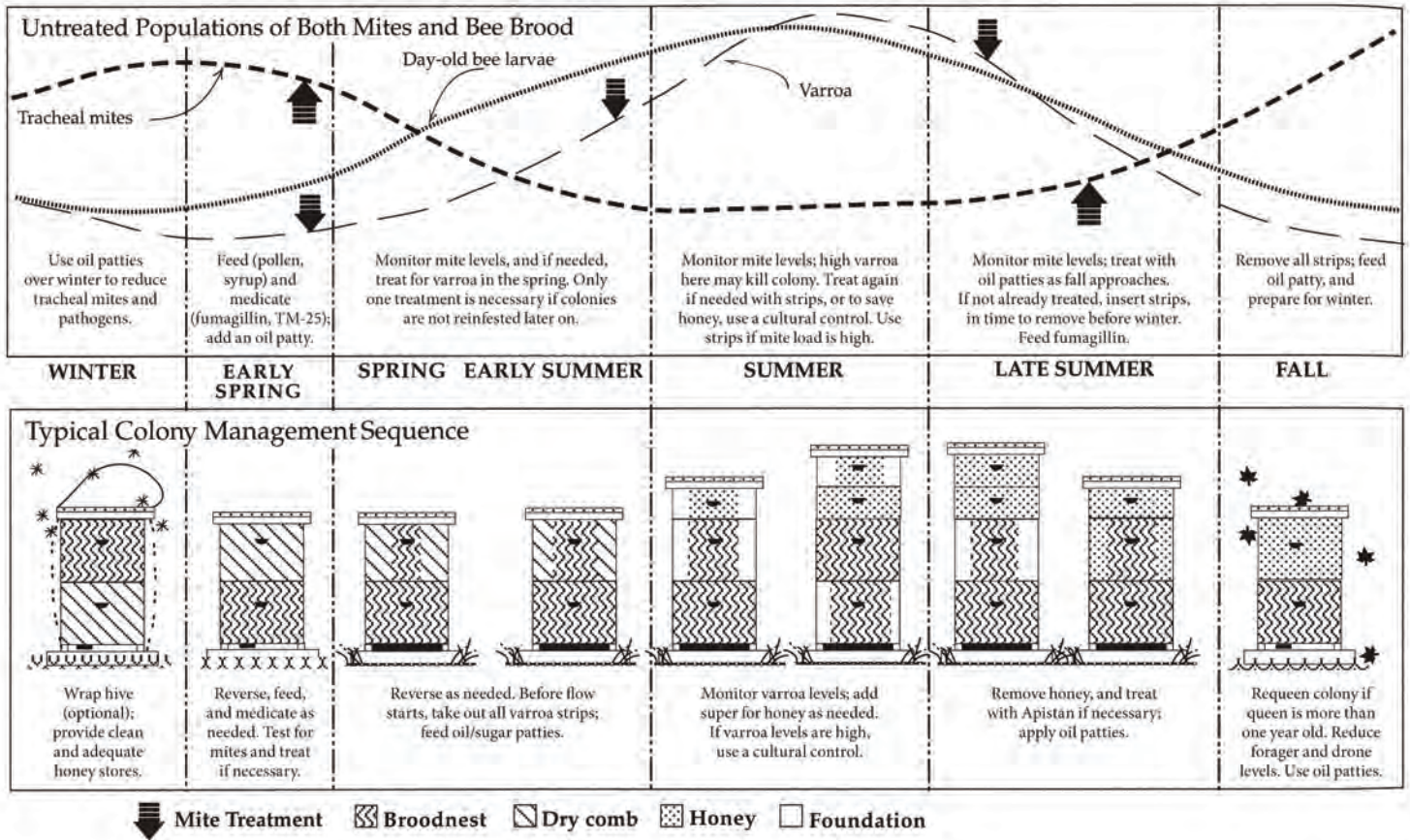
- Beekeepers, with diseased equipment, tools, or bee suits.
- Cells, in which larvae hatch, may contain spores.
- Spores, present in honey and/or pollen, are passed on to larvae by nurse bees feeding them.
- Cleaning bees, spreading spores throughout hive when attempting to remove dead brood or scales.
- Robbers from diseased colonies, entering an uninfected hive or bees robbing a diseased colony.
- Bees drifting from diseased to clean colonies.
- Swarms that have AFB.

Symptoms

The symptoms of AFB are varied and sometimes are confused with other diseases or even mite infestations. Here are some things to look for:

- Brood pattern is irregular rather than compact.
- Healthy larvae are glistening white; diseased ones lose this appearance and turn from light brown to dark brown. Larvae die upright, not twisted, in cells.
- Since the death of larvae and pupae often occurs after their cells are capped, the cappings become concave and some will be punctured by bees attempting to remove the dead brood (see the illustration on this page). These puncture marks are very prevalent.
- Surface of cappings will be moist or wet rather than dry.
- Larvae long-dead develop the consistency of glue and are difficult for bees to remove.
- Eventually dead larvae dry out; the dried remains or scales adhere to the bottom, back, and side walls of the cell and are difficult to remove as well.
- Some dead pupae, shrunk into scales, have their tongues protruding at a right angle to their scale or straight up. This may be the only recognizable characteristic, but it could also be missing.

Sequence of Suggested Treatment Times for Bee Mites



rally drop out. Check the catalogs to see what is available. To make counting easier, a company in Michigan (Great Lakes IPM) makes a board with a third of the grid blackened for easier counting; they also come in nuc sizes.

Treatment for Varroosis

Choose the treatment appropriate to the season. If high mite populations are found during the summer honeyflow (most common), you cannot put in chemical acaricides, as this will contaminate honey and beeswax.

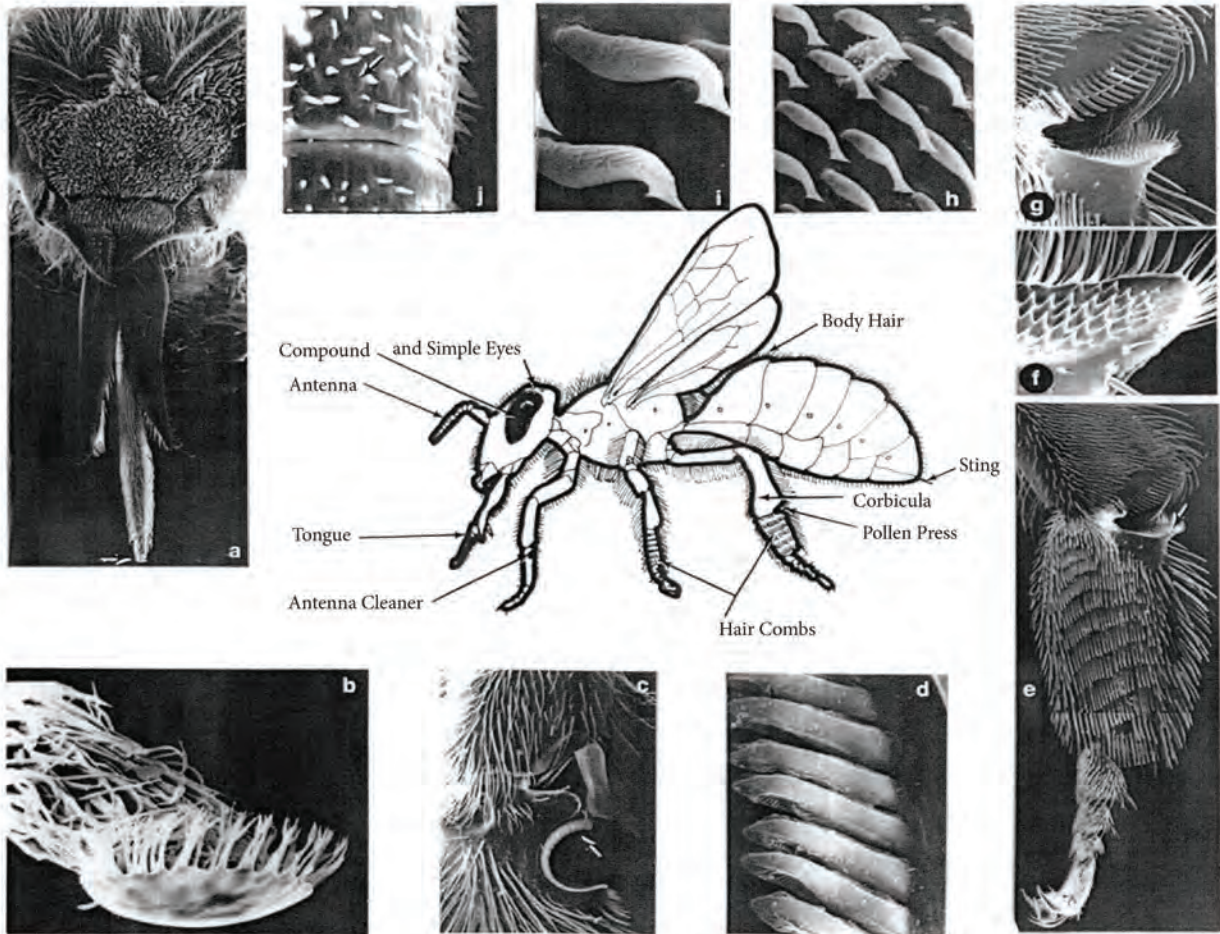
To date there are only a few chemical control products registered for treating varroa: Apistan, a plastic strip (like a flea collar) impregnated with the pesticide fluvalinate. Apistan is now mostly replaced with CheckMite+ strips (active ingredient is coumaphos) because the mites, in many areas, are resistant to fluvalinate. Other chemical acaricides include formic acid and a commercial product (Apilife Var); these two are the only approved control chemicals in the United States. Sucroicide is another product, but

some researchers have not found this to be very effective. Acaricides are generally placed in colonies in early fall, after the honey supers have been removed (see the chart of the sequence of suggested treatments on this page) and again in the spring. Due to the ineffectiveness of some of these chemicals, check out other options now available.

Other products that are coming are Hivastan and ApiGuard. Check to see if these are permitted (some still have an EPA Section 18 Emergency Exemption) or are not yet approved. All registered chemicals are available from bee supply companies, and it is important to follow the label directions carefully. Do not be tempted to use other, home-made chemical cocktails, as some of these are now being detected in the honey and especially the wax, making them unfit for human consumption, use, or sale. Timing of treatment is very important.

Formic acid is effective but its liquid form is very dangerous to use. It acts as a fumigant, killing both types of parasitic mites, but it can be toxic to bees too if not applied correctly. It is **extremely caustic to**

What Makes Bees Exceptional Pollinators

**WORKER: WHAT MAKES BEES EXCEPTIONAL POLLINATORS**

As mentioned in Chapter 2, the diagram showing the worker anatomy gives the names of the parts of a worker honey bee. In the diagram here, the parts of the worker are blown up using a scanning electron microscope (SEM) to give the fascinating details of how this pollinating machine is put together. Diagram includes:

- a. the head of a honey bee, showing the mouthparts.
- b. The tip of the proboscis which has sensory hairs to help guide the proboscis to the nectary as well as to provide information on the food being ingested.
- c. Close-up of antenna cleaner, showing modified hairs that act as a comb. The antennae are important sensory organs of the bee and must be kept clean and free of debris.

- d. Close-up of the modified hair comb of antenna cleaner in *c*.
- e. Hind leg showing the hair combs (corbicula) that help make the pollen pellet. The hairs are aligned in one direction to keep the pollen sorted. Pollen press is on the top.
- f. Close-up of base of pollen press.
- g. Pollen press showing modified hairs to collect pollen grains.
- h. Close-up of modified hairs on hind leg of bee with a captured pollen grain from a sunflower.
- i. Modified hair in *h*, at higher magnification; the peg-like hair aid in collecting pollen grains.
- j. Close-up of antenna showing the sensory hairs and pegs that enable the bee to smell.

For more information and photos, see Erickson et al. 1986, in References under “Bees and Beekeeping.”

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