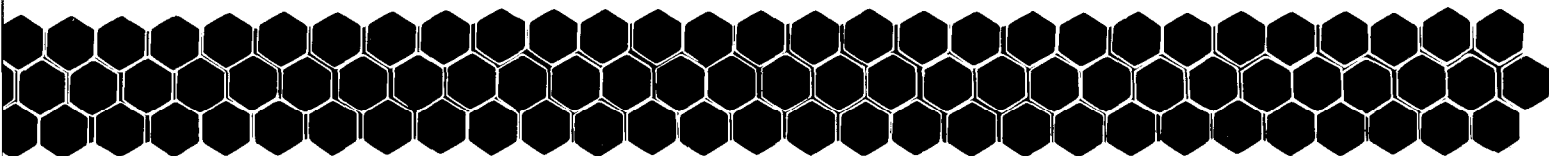


Honey-

Guide to Efficient Production

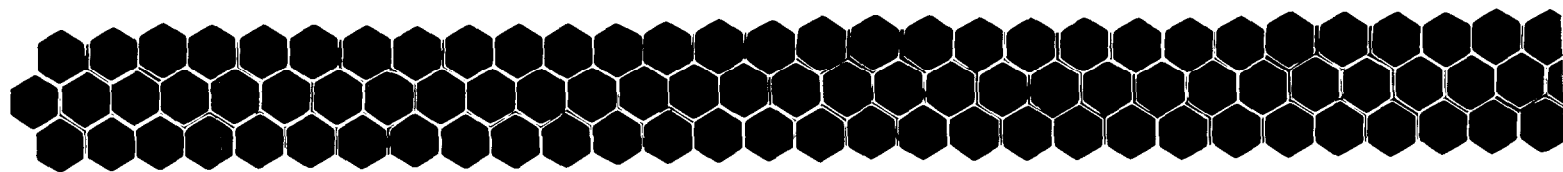
Walter L. Gojmerac





CONTENTS

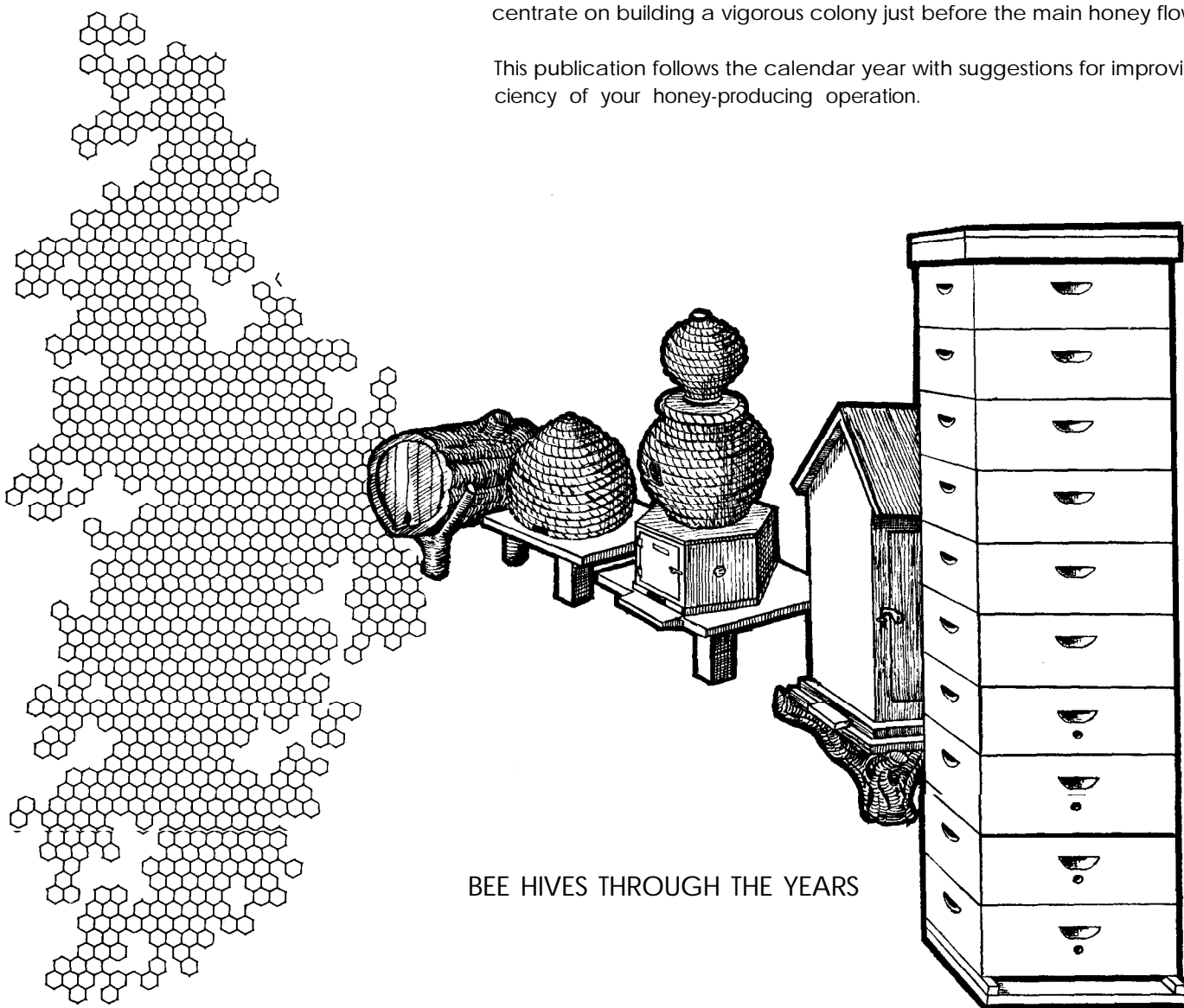
JANUARY	3
Cold Weather.....	3
FEBRUARY	4
MARCH	5
Spring Losses	5
Emergency or Spring Feeding.....	5
Feeding Pollen Supplement.....	6
Pollen is Crucial.....	6
APRIL	7
Packaged Bees	7
Introducing and Releasing Queens.....	8
Release Queen Directly.....	8
Extra Queens	10
MAY and JUNE	11
Trapping Pollen	11
Construction a Trap.....	11
Storing Pollen	14
Time to Divide.....	14
If You Can't Find the Queen.....	14
Two Queen Colonies.....	14
Auger Holes.....	16
Selling Packaged Bees.....	16
Swarms	16
Reversing	17
Drift	17
JULY and AUGUST	18
Honey Flow	18
Bottom Supering	19
Removing Supers.....	19
Trapping Pollen	19
SEPTEMBER-DECEMBER	20
Fill the Brood Chambers.....	20
PROBLEMS	21
Bee Diseases	21
Nosema	21
Brood Diseases.....	22
Insecticides and Bees.....	23
HONEY HANDLING	26
Beekeeping Records	27
Watch Bees Work by Building and Operating Observation Beehive.....	28
ADDITIONAL INFORMATION	32



People have practiced the art of keeping bees for centuries. Some techniques and practices which have been used successfully for years are still considered part of good management. Other practices have grown obsolete because they are not the most efficient way to manage a colony. For example, it is no longer important to know how to "hive a swarm," because if a swarm leaves the hive, honey production is significantly reduced. It is very important that bees do not swarm.

Remember that bees are wild animals. Because bees haven't been domesticated, you will have to improve your own skill working with them. Carefully observing them to better understand their behavior allows you to capitalize on certain bee instincts. By knowing that a strong colony produces a large honey crop, you can concentrate on building a vigorous colony just before the main honey flow.

This publication follows the calendar year with suggestions for improving the efficiency of your honey-producing operation.



BEE HIVES THROUGH THE YEARS

January

By October or November the queen stops laying and takes a well-deserved rest. Let us now follow the colony's activities beginning with the New Year. Sometime in January the queen begins to lay eggs in the center combs of the winter cluster. A large cluster of bees with an ample amount of honey and pollen begins to raise brood without interruption. Young bees emerge daily replacing the old bees which normally die.

COLD WEATHER

Bees are unique because they can regulate the hive temperature with their muscular movements. The hum you hear in a colony comes from bees moving their wings and wing muscles to produce heat. As the hive temperature drops, their cluster tightens; as it goes up, the cluster expands. All during this period the bees use honey as a source of energy. A low temperature for a short time (one or two days) is not harmful to bees. However, prolonged low temperatures can spell disaster, because the cluster is packed tightly over several combs. If the cluster runs out of honey, all the bees will starve even though honey may be one or two frames away.

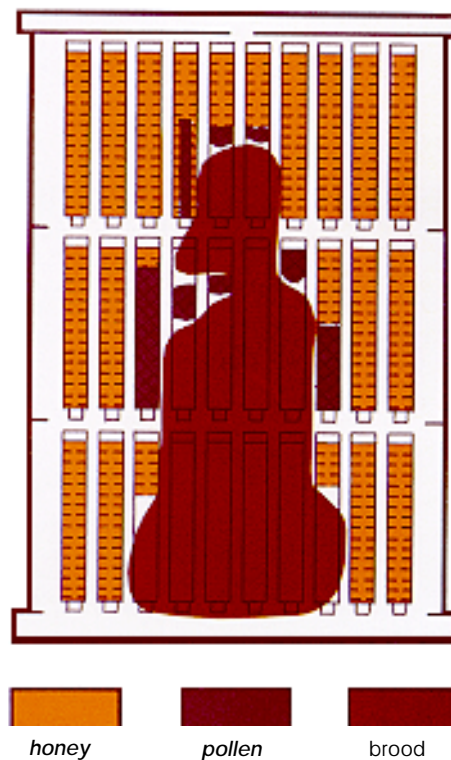
Ideal overwintering weather consists of alternating cold and warm spells. This gives bees the opportunity to move around, to do some routine housekeeping such as removing dead members from the colony, to transport honey to the cluster, and to take a cleansing flight.

THE WINTER CLUSTER

The position of the winter cluster is important because it determines whether the bees will be able to consume both honey and pollen during the coldest weather. If pollen is not available, the bees cannot produce the royal jelly necessary for feeding the queen and young larvae. Brood rearing slows down and stops about two weeks after they exhaust the pollen supply.

An ideal winter cluster and its food supply are illustrated in Figure 1. The top brood chamber has nearly all its combs full of honey and pollen. The queen begins to lay in the upper brood chamber, while the bees consume honey to provide additional empty cells. The honey in the lower brood chamber will be used in the spring. You can move it upward during warm periods in late winter or early spring as needed.

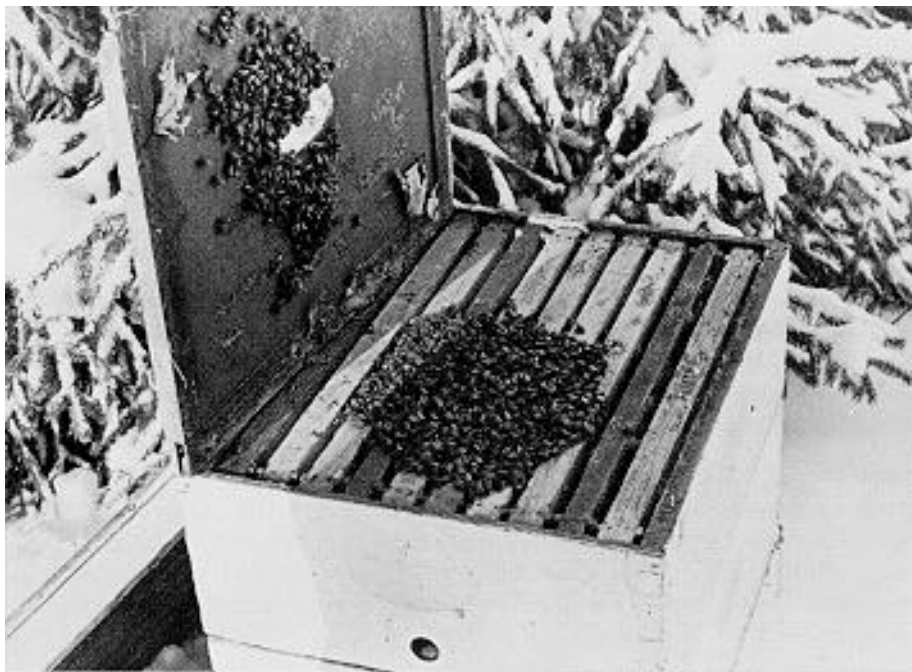
Figure 1. Ideal position of winter brood nest.



February

A February inspection can save your colonies from a major cause of winter losses—starvation. In spite of good management, even the strongest fall colonies might need some supplementary feeding in February, March or April. You can generally estimate the amount of honey in the colony by lifting one edge of the top chamber; you don't need to open all colonies.

On a quiet bright day when the temperature is above 20°F, open the colony carefully and slowly. Blow enough smoke over the bees so they won't fly up and become chilled. The bees should go down between the combs. You can often see the brood without removing any combs. At this time the frames of honey and pollen should be next to the brood and cluster of bees. If these combs are empty or contain honey only around the outside edges, then feed sugar or move the combs of honey in to replace the empty combs. While the colony is open, also check for pollen. If none is within the cluster, broodrearing will stop shortly. To avoid this, feed pollen supplements or place combs of pollen from other colonies inside. Do not break open the cluster.



Winter cluster of bees in upper position of hive.

What you do during March and April partly determines the size of the year's honey crop. It is during this time that you can build large colonies. To produce brood the colony needs pollen and honey. Without pollen the queen stops laying and the colony may survive until the first flowers bloom. Observations and research have demonstrated, however, that if you provide the colony with enough pollen, the queen will increase her egg laying during March and April so that you have a large colony at the beginning of honey flow.

SPRING LOSSES

During March check the colonies regularly to make sure they have ample honey. You need not open each one. With a little experience, lifting one side will indicate which colonies are light and need feeding. Many overwintered colonies are lost in early spring because keepers took too much honey in the fall. A strong colony the previous year will have gathered a sizeable amount of pollen, plus a good honey crop which is then removed. During January and February the queen begins to lay. With sufficient pollen she continues to lay eggs at a rapid rate, using somewhat larger amounts of honey. This large population can run short of honey and starve.

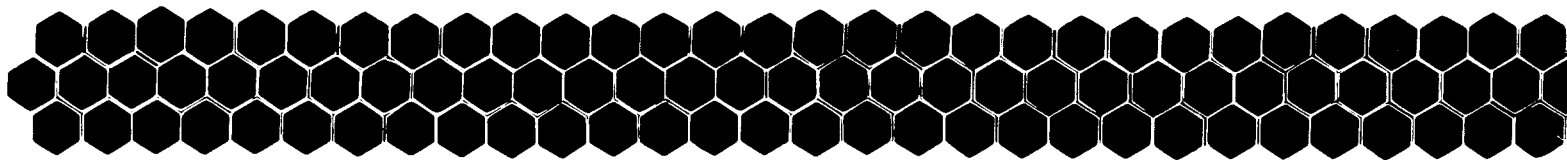
By carefully observing these colonies and feeding the light ones with sugar (see next section) during this period you can save them, then the bees will have survived the most critical part of the season.

EMERGENCY OR SPRING FEEDING

Sugar dissolved in hot water makes satisfactory bee feed. You can make this sugar syrup by dissolving 2 pounds of sugar in 1 pint (pound) of hot water. Adding fumagillin (Fumidil B) to this mixture helps reduce nosema, a parasite. (See later section on nosema.) At this time of the year the colony is expanding. The workers are cleaning soiled, nosema-infected combs. Fumagillin keeps the infection low.

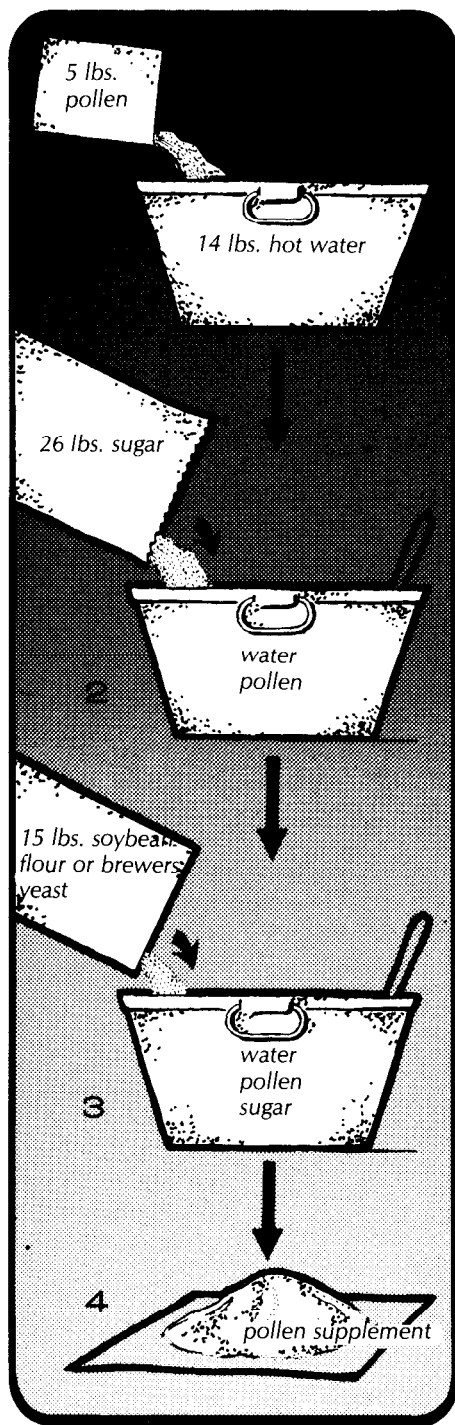
If your bees can leave the hive to bring in water, you can feed them easily by placing granular sugar in several combs and on top of the inner cover. Bees will consume the sugar and use it as well as sugar syrup, but only if they have enough moisture inside the hive or can go outside.

A recent development is the availability of high fructose corn syrup which is made from corn starch. Available under several trade names, high fructose corn syrup may be used instead of granular sugar. Although this is an excellent bee food for those equipped to handle liquid, it can adulterate the honey if it is used incorrectly.



FEEDING POLLEN SUPPLEMENT

Figure 2. Preparing pollen supplement.



Commercially prepared pollen supplements and pollen substitutes are available from bee supply houses. You can make your own mixture by trapping pollen during the summer, storing it until March and then adding soybean flour or brewer's yeast to extend it. Be sure to use only "fully toasted" soybean flour, torula or brewer's yeast. Animal feed grade products are satisfactory and more economical. Companies which handle beekeeping supplies usually handle the correct products. But if you plan to purchase them from another source, first inquire if they are satisfactory for bee food. Do not use soybean meal because it is too coarse for the bees.

Begin feeding pollen supplements or substitutes from mid- to late March. The earlier you start, the better your chances are of having a larger colony at the beginning of honey flow. However, you may have to feed extra sugar later in the season before nectar is available in April, especially if there is poor bee weather. Once you begin feeding pollen supplements, you should continue so brood rearing is uninterrupted. Continue feeding the pollen supplement into May or whenever the first pollen is available.

You can make your own pollen supplement if you've collected pollen the previous summer (as described in a later section). Mix 1 pound of pollen with 3 pounds of soy flour or brewer's yeast. Make this dry material (4 pounds) into a moist cake using 2 pounds of sugar syrup (for recipe, see section on emergency or spring feeding).

You may have difficulty moistening the pollen or yeast with sugar syrup. To overcome this blend the pollen or yeast with water, then add the other ingredients as illustrated in Figure 2.

The final mixture should have the consistency of a thick paste. If it is too soft it will run between the frames, and if too dry the bees will refuse it.

For each colony place about 1-½ pounds of supplement on a piece of waxed paper. Remove the hive cover and smoke the bees down from the top frames. Place the cake directly over the center of the cluster. Leave the paper on top to prevent drying. Replace the inner cover in an inverted position to provide space for the cake. The 1-½ pounds of supplement should last for 10 to 14 days. Add a new supply before the bees completely consume the cake. If a colony does not consume the supplement it may be queenless or too weak to raise brood, or the cake may be too dry.

POLLEN IS CRUCIAL

Colonies with ample pollen replace their fall populations by the time new pollen is available. Usually they are strong enough to replace their stores consumed during the winter with nectar from willows, dandelions and fruit blooms.

Colonies unable to rear brood for lack of pollen may not collect sufficient nectar to maintain their colony weight during the early honey flow. These colonies seldom reach maximum productive strength by the time the main honey flow begins.

If combs are disease-free you may exchange combs to equalize pollen reserves among colonies in the same apiary. Colonies that are queenless when the flora is abundantly producing pollen accumulate large reserves because they are not using it to feed larvae.

PACKAGED BEES

Install packaged bees purchased from Southern producers in early April in areas where the honey flow begins by about June 15. Farther north, install packaged bees two weeks later.

Packaged colonies usually require 10 to 12 weeks to reach maximum population. A two-pound package supporting a good queen will develop a full strength colony in virtually the same time as a three-pound package.

A three-pound package is suggested if you start on foundation. The extra bees can build comb, but if you have a drawn comb, a two-pound package is adequate to rear brood.

Note the population curve on the graph in Figure 3. You will have a reduced population just before new bees begin to emerge. This is normal.

Buy quality stock and provide ample pollen supplement and honey (sugar syrup) for uninterrupted brood rearing. (See later section on trapping pollen.) If you provide enough honey and pollen, packaged colonies established 10 to 12 weeks before the honey flow can develop to full strength in almost any weather conditions. When reserve pollen is not available, it is safer to delay installation until the beginning of dandelion bloom. Packages established later under favorable conditions will be strong, although not full strength at the beginning of the flow.

Number of Bees

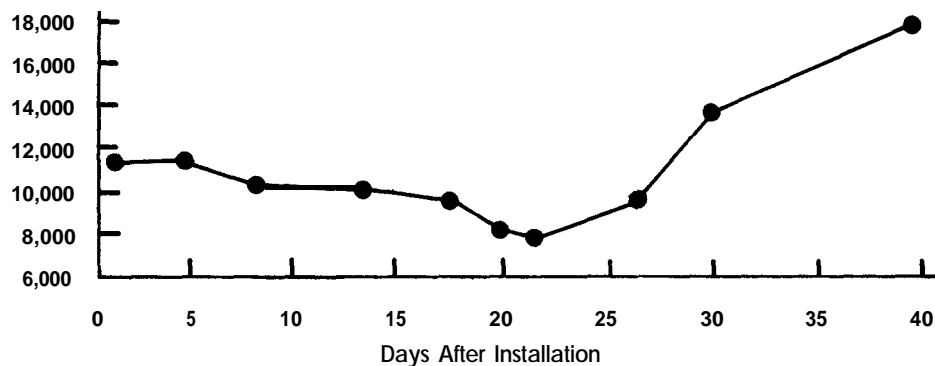
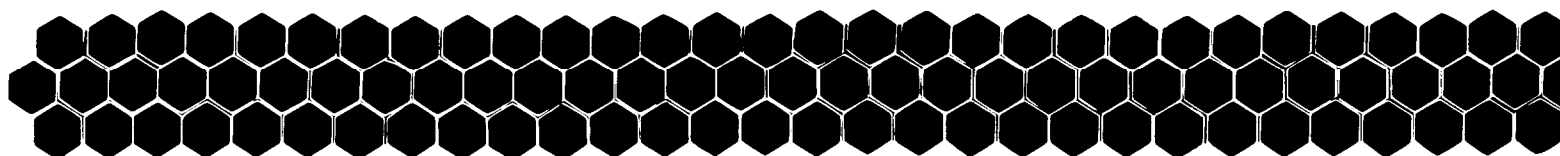


Figure 3. The growth of the population in a three-pound package bee colony. Since no bees emerge during the first three weeks, the colony population decreases rapidly as older bees die. After three-weeks, and young bees emerge, the population of the colony starts increasing and reaches its original size about four weeks after package installation (Cornell University Cooperative Extension Service).



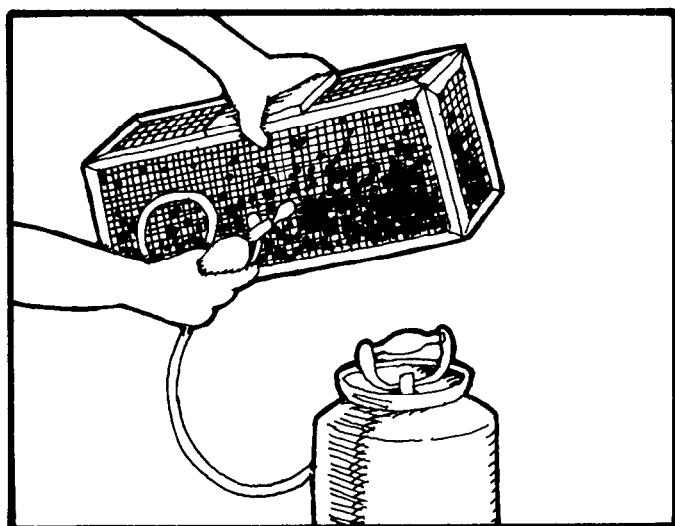
INTRODUCING AND RELEASING QUEENS

Observations over a number of years suggest that if you release a queen immediately into the packaged bees she will begin laying at least three days earlier than if introduced by the cage method. Bees may drift from packages that do not start brood rearing quickly to packages that have their brood nest well organized. If the queen is released at once in all packages, drifting is usually reduced.

Gorged bees are in an ideal condition to accept a queen. You can feed them much better with a small knapsack sprayer than by brushing or dipping. The knapsack sprayer is especially valuable to beekeepers who install many packages or introduce queens.

Use the following procedures when you install packaged bees: On arrival, gorge the bees by spraying. Use a thin syrup of equal parts of sugar and water containing Fumidil B. Feed it warm. Spray the package on all sides several times (See Figure 4). You won't hurt the bees by wetting them thoroughly unless it's cold. Do not wet bees with sugar syrup during cold weather (30°-40°F). Some may become chilled and die, and they normally don't fly outside at these temperatures. Remove at least five center combs from the brood chamber. This allows space into which you can shake bees.

Figure 4. Spray packaged bees with syrup. Because bees will pick up nosema spores from feces in the cage, it's a good practice to add Fumidil B to the sugar syrup you use to spray packaged bees.



If possible give them extra combs of honey and pollen. Otherwise, provide sugar syrup. Use the deep side of the bottom board to allow room for the bees to spread under the frames when they are released. Reduce the size of the entrance to a very small opening and plug the auger hole loosely with green grass or thin paper. If the weather is warm, it is best to wait until evening to avoid robbing. Just before opening the package, spray the bees thoroughly again to quiet them and prevent them from flying. Shake the bees into one end of the package. Cut three sides of the screen on the upper end. Remove the queen cage. Then shake the bees into the hive. Dislodge any remaining bees. To save the package for reuse, remove the feeder can from the hole on the top and vigorously shake bees through this opening. If you thoroughly spray the bees they won't fly out. Spread the bees over the bottom board with a hive tool to prevent mashing when the frames are replaced.

RELEASING QUEEN DIRECTLY

Spray the queen thoroughly with warm sugar syrup to prevent her from flying. If one of the queen's wings was clipped there is no danger of her flying away. Replace all the frames. Carefully rip the screen from her cage, hold the cage low over the bees and slowly shake her into the cluster. Watch her carefully so that she isn't injured. Remember: directly release a queen into the packaged bees only if she was shipped inside the package. Strange or foreign queens must be released by the slow release method (See Figure 14).

If you provide combs of pollen and honey you don't need to do anything more at this time. In about two days the queen should start laying. You may need between 15 and 25 pounds of honey per colony for feeding the bees you obtained in early April. Fill empty combs with sugar syrup and give them to the packaged bees the same as combs of honey. Provide at least four combs filled on both sides. Three to five days after installation inspect the colonies to see if all is well.

If you must install packaged bees on foundation, wait until about May 1 or the beginning of fruit and dandelion bloom. Then liberally feed sugar syrup of two parts sugar and one part water until all combs on the brood chamber are drawn or a honey flow develops and the bees stop taking syrup. If possible provide one or two dark brood combs so that the queen can begin laying at once. Feed these bees sugar syrup with the inverted pail rather than the bottom board (Boardman) feeder. If it is cold bees may starve rather than feed from the bottom board feeder.

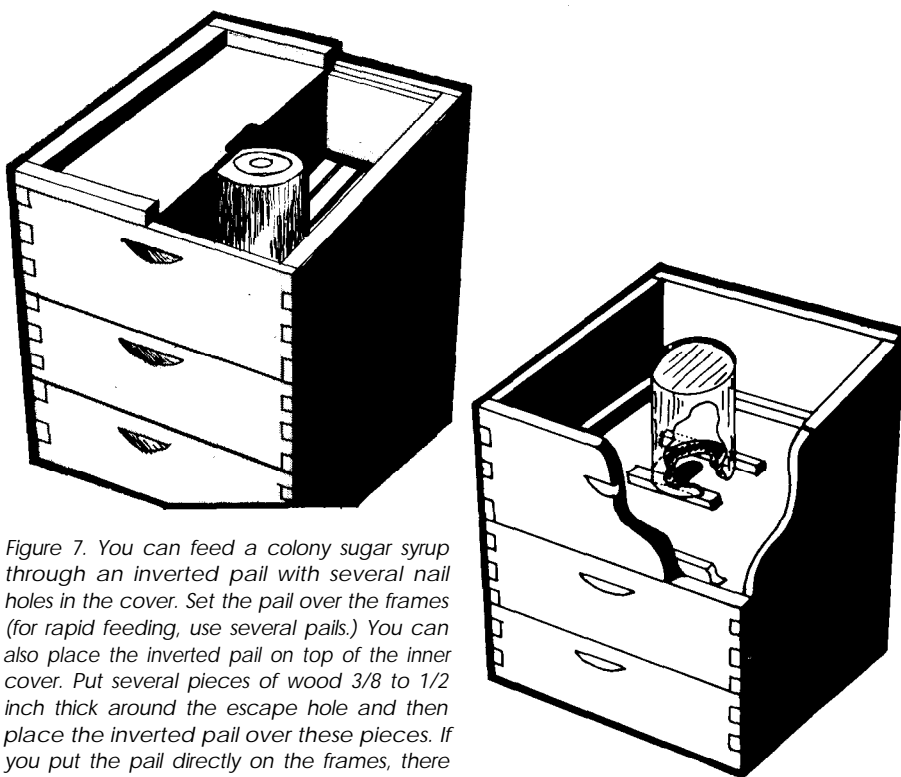


Figure 7. You can feed a colony sugar syrup through an inverted pail with several nail holes in the cover. Set the pail over the frames (for rapid feeding, use several pails.) You can also place the inverted pail on top of the inner cover. Put several pieces of wood $\frac{3}{8}$ to $\frac{1}{2}$ inch thick around the escape hole and then place the inverted pail over these pieces. If you put the pail directly on the frames, there is a chance the bees will start building extra comb in the empty spaces around the pail.

Figure 5. Probably the best method of removing the bees from the package is to shake them into a space in the new hive made by removing several frames.

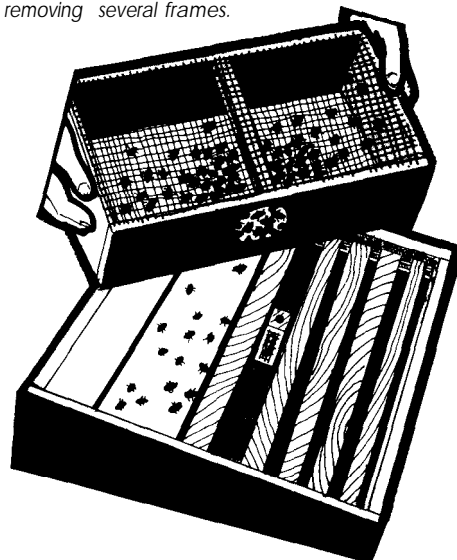
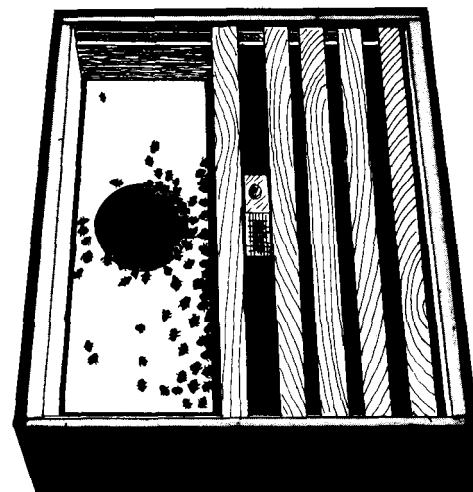
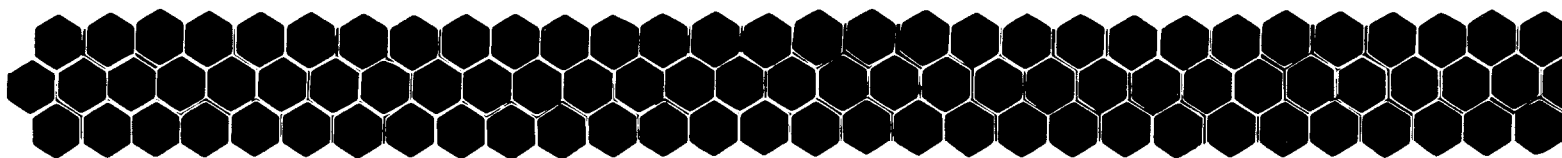


Figure 6. One method of installing a package is to place it in the hive and allow the bees to exit by themselves and join the queen. The queen cage should be placed, candy end up, between two frames. Since this creates an abnormally large space in the hive which may be filled with unwanted comb (burr comb), remove the queen cage after a few days. See Figure 14 illustrating how to prepare the queen for slow release.





EXTRA QUEENS

When ordering packaged bees, it is wise to order extra queens. Experienced beekeepers usually order three extra queens for every 10 packages. If a queen is lost on introduction or fails to become a laying queen, it is too late to order another one by mail. You can hold queens for installation for several days at room temperature by giving them a drop of water twice a day. For longer holding periods, install them in nuclei. Divide a package of bees into three parts and give a queen to each one. These queens will start laying, and you can easily install them in colonies when necessary. To install a queen from a nucleus, spray the bees, queen and queenless colony with a thin, warm sugar syrup. Place the combs with queen, brood and bees in the center of the colony to be requeened. Queens introduced in this way will continue to lay without interruption.

You can also introduce laying queens by the spray method. Spray the bees of the queenless colony with syrup; then spray the queen in the nucleus. Gently pick her up and place her on the brood of the colony. Bees readily accept a laying queen this way. Try to unite the queenless package with another queen as soon as you discover it is queenless.

ABSCONDING If you install package bees on a warm sunny day, be sure to engorge them before shaking them into the hive. Also provide them with one or two frames of honey or feed them with sugar syrup. Newly installed bees have not accepted or adjusted to their new home. If allowed to fly, they could join up with another nearly established colony or unite with another nearby package. The ideal time to install package bees is during inclement weather when bees stay home naturally. Or you can force them to remain in the hive for several days by plugging the entrance with green grass. In several days the grass dries, and the bees will work their way out.

Laying queen with wing clipped



TRAPPING POLLEN

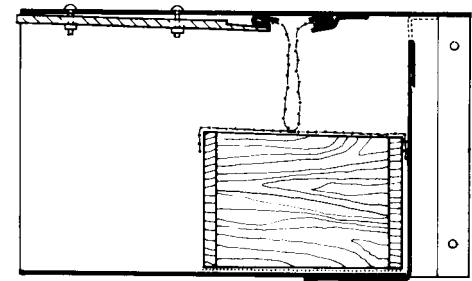
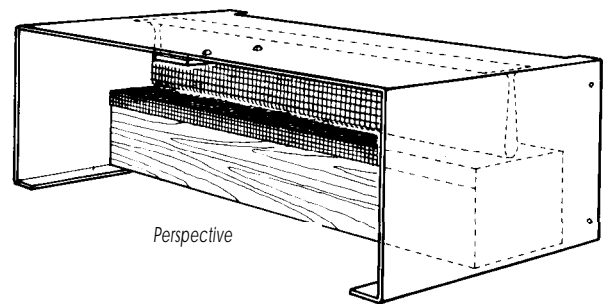
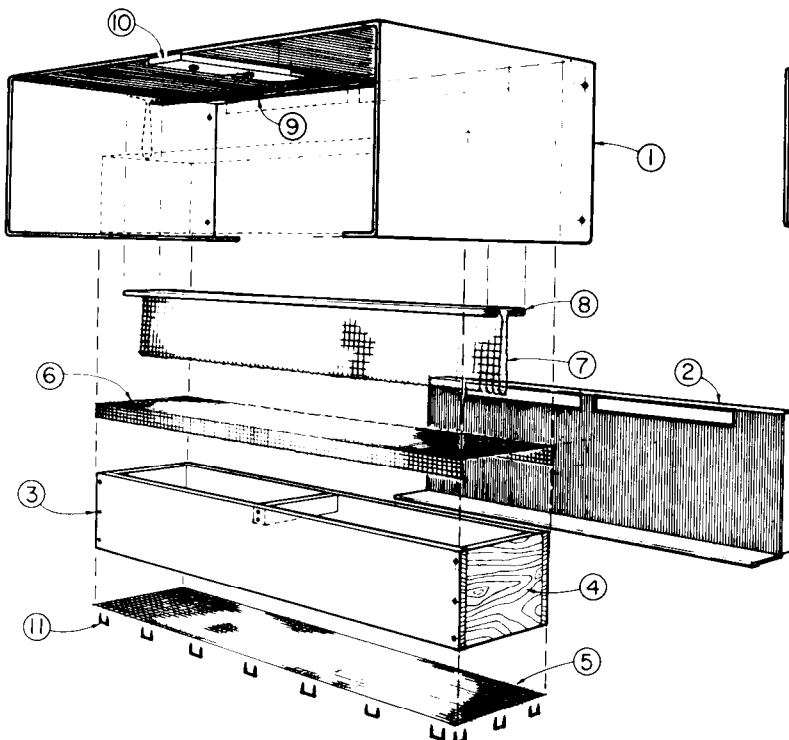
Because feeding bees pollen supplements in early spring is so important, you may wish to trap pollen in May and early June to extend with soy flour. Trap from about two percent of your colonies. Remove the traps during the main honey flow. You can trap pollen again after the main honey flow in August.

CONSTRUCTING A TRAP

There are a number of different types of pollen traps which force bees to crawl through a 5-mesh (5 holes/inch) hardware cloth, dislodging pollen pellets from their legs and into a receptacle. The cover of the receptacle should be made of 7- or 8-mesh hardware cloth to keep out bees and debris. Freshly collected pollen is high in moisture and will quickly mold. To increase air circulation and reduce the possibility of mold, the bottom of the pollen receptacle should be made of fine mesh copper screen.

You can improve the efficiency of the trap by using two pieces of 5-mesh hardware cloth, slightly offset and separated about 1/4 inch. While the design and location of the trap may vary to suit the interests and needs of the beekeeper, it is best to allow bees to adjust to the entrance before installing the trap. Your equipment should be tight and other entrances must be closed.

Figure 8. Galvanized steel sheet pollen trap: (1) Trap body—Galvanized steel sheet, 26 gage, 28-1/4 by 8 inches, formed as shown. (2) Trap back—Galvanized steel sheet, 26 gage, 17-1/4 by 7 inches, formed as shown and spot-welded into trap body. (3) Pollen tray sides—Wood, 16-3/16 by 2-1/2 by 1/4 inch, two required. (4) Pollen tray ends—Wood, 3-1/4 by 2-1/2 by 1/4 inch, two required. (5) Pollen tray bottom—Copper screen, 16-3/8 by 3-3/4 inches, soldered along edges for rigidity and finish. (6) Pollen tray cover—Hardware cloth, 7- or 8-mesh, 16-1/4 by 6 inches, formed as shown to fit pollen tray. (7) Grid—Hardware cloth, 5-mesh, 16-1/4 by 5 inches, formed as shown to provide double grid. (8) Grid edge strips—Galvanized steel sheet, 16-1/4 by 1 inch, formed as shown to finish grid edges, two required. (9) Grid hanger—Galvanized steel sheet, 16-1/4 by 1-1/2 inches, formed as shown and spot-welded to trap body. (10) Grid latch—Plexiglass, 4-1/2 by 1-1/2 inches, formed as shown and bolted into place. Other material may be used. (11) Staples to fasten bottom screen to pollen tray.



Section

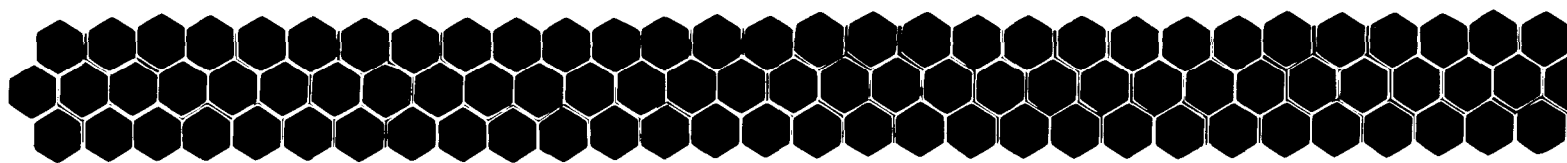


Figure 9. Special hive body used with galvanized steel sheet pollen trap.



Figure 10. Galvanized steel sheet pollen trap installed on a colony.

GALVANIZED STEEL SHEET POLLEN TRAP The trap in Figure 8 is made of galvanized steel sheet. Assembly details are given on the line drawing, and width dimensions can be changed to fit the hive. The double screen grid is installed so that it can be removed from the trap. When the grid is fabricated, the ends and top are left open to remove the dead bees easily. The pollen tray is wood with a screened bottom. The top of the tray slopes downward slightly from the front to rear to insure a tight fit of the hardware cloth cover against the grid.

A special hive body is needed with this trap. Where the trap attaches, cut a saw kerf horizontally across the front of the hive body one inch down from the top. A 1/2-inch high and 1/4-inch long entrance slot is centered in the body and lies immediately below the saw kerf (Fig. 9). The top of the trap is inserted into the saw kerf during installation on the special rim to provide a weatherproof connection and align the entrance slots of the trap and hive body. Use two screws on the sides of the body to hold the trap in position. The trap installed on a colony appears in Figure 10. For installation, substitute the body with the trap for one of the brood chamber bodies on the colony. With the trap in place the colony then can be worked normally with no disturbance to the colony other than changing the location of the entrance when the bodies are rotated.

When you install the trap on the colony, remove the screen grid for at least two days to permit the bees to become accustomed to entering the hive through the trap. After this orientation period, the grid may be inserted and removed as desired. The trap without the grid may be left on the hive for the entire season without adverse effect. The grid should be installed only when trapping pollen. Additional entrances may be desirable during heavy honey flows.

AUGER-HOLE POLLEN TRAP The trap shown in Figure 11, made of wood, is simple in design. The trap is made for hives with 1-1/8 inch auger-hole entrances. Pollen is collected in the body of the trap making a separate tray unnecessary. The size of the trap should hold at least one day's collection when the pollen flow is at a peak. This amount will vary depending on locale and can be determined by experience. The dimensions given for the line drawing provide sufficient volume in most instances.

A trap with the front and cover removed is shown in Figure 12. Bees enter the hive from the trap through a piece of 1-1/8 inch diameter tubing that also serves as the mounting for the trap on the hive body. Mounting is accomplished by inserting the tubing into the entrance hole. The screen grid can be removed to clean or to allow the bees unrestricted flight. An orientation period is not necessary for this auger-hole trap.

Before the pollen collection period, open the auger-hole entrances so that the bees become accustomed to using them. When the traps are installed, all entrances except those with traps are turned to the back of the colony or closed with corks or bottle caps. This includes the bottom entrance as well as any auger holes without traps. Install the traps only during pollen flows of 1/4 pound per day or more, and remove them when the pollen flow dwindles or when a nectar flow of five pounds per day or more is in progress.

This trap is removed from the colony to empty the collected pollen. Pollen is emptied from the trap by removing the bottom screen. More than one trap may be used on a colony; however, pollen traps should be removed for colony manipulations and then replaced. A hive with one trap installed is shown in Figure 13.

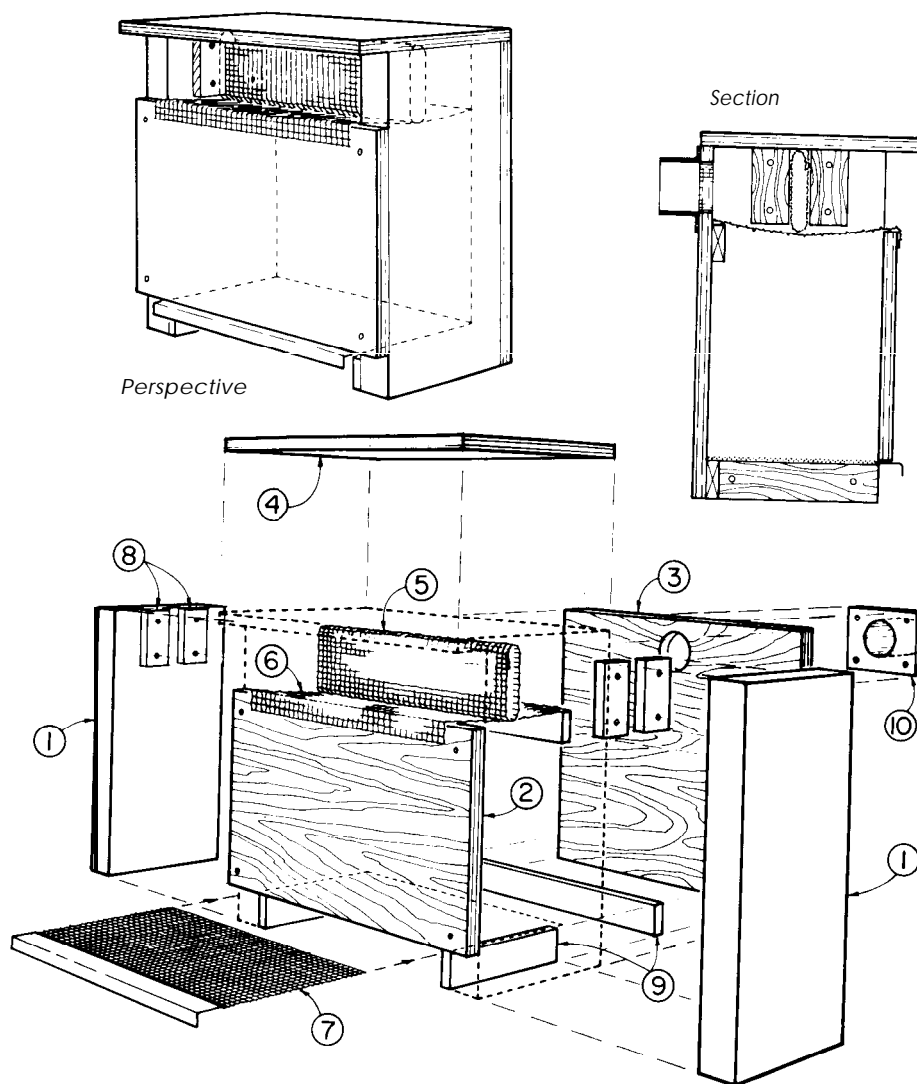
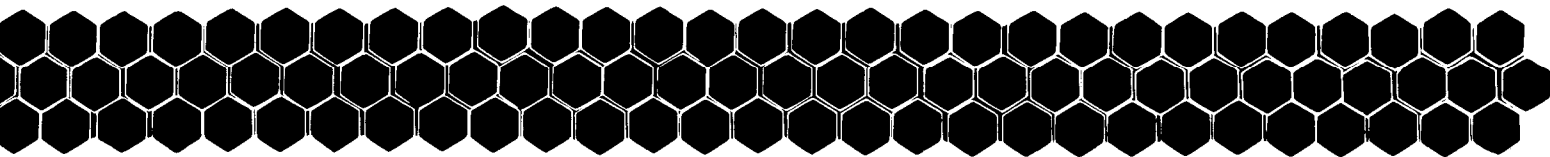


Figure 11. Auger-hole pollen trap. (1) Trap sides—Wood, 3-1/4 by 7 by 3/4 inch, two required. (2) Trap front—Fir plywood, 8 by 4-5/8 by 3/8 inch, exterior grade. (3) Trap back—Fir plywood, 8 by 7 by 3/8 inch, exterior grade. (4) Trap cover—Fir plywood, 8 by 4-1/2 by 3/8 inch, exterior grade. (5) Grid—hardware cloth, 5-mesh, 6-3/8 by 3-1/2 inches, formed as shown. (6) Pollen collecting container cover—Hardware cloth, 7- or 8-mesh, 6-3/8 by 4-1/2 inches, formed as shown. (7) Pollen collecting container bottom—copper screen, 4 by 6-3/8 inches. A galvanized steel sheet strip is soldered to one edge as shown to provide stiffness and ease of removal. (8) Grid supports—Wood, 1-1/2 by 3/4 by 1/4 inch, four required. (9) Pollen collecting container cover and bottom supports. Wood, 6-1/2 by 3/4 by 1/4 inch, two required, and 3-1/4 by 3/4 by 1/4 inch, two required. (10) Entrance and mounting tube—1-1/8 inch diameter copper tubing 3/4-inch long soldered to galvanized steel sheet 2 by 2 inches and nailed over 1-inch auger hole in trap's back.

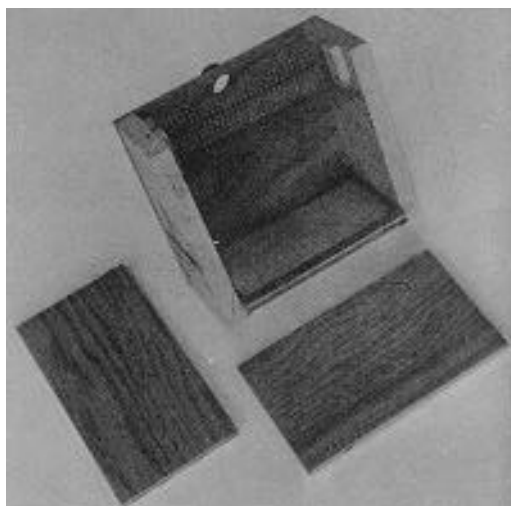


Figure 12. Auger-hole trap with front and cover removed to show grid and screens.



Figure 13. Auger-hole trap installed on a colony.

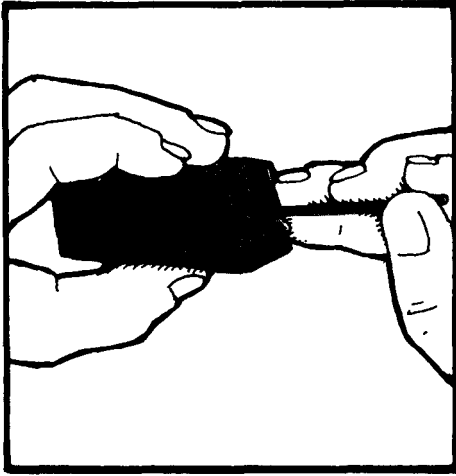
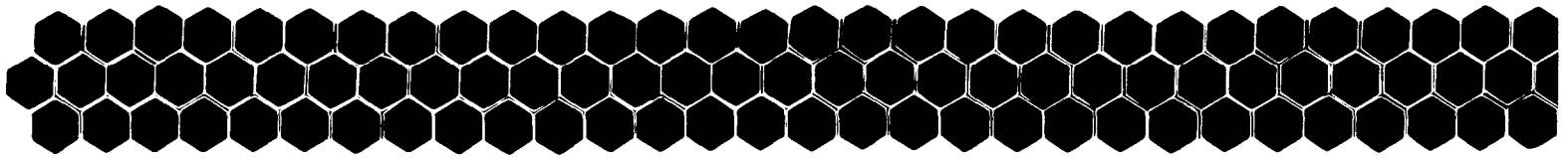


Figure 14. To release the queen slowly, remove the end plug on the queen mailing cage. Make a hole in the candy plug with a nail, then place in the cage with the candy plug in the hole, *slanting upward*. Worker bees will chew away the remaining candy and release the queen.

CARE OF TRAPPED POLLEN Freshly trapped pollen is perishable and must receive special attention to prevent loss. It may be dried, frozen, or mixed with another material and stored.

When the pollen is dried, spread it about 1/2 inch deep on a flat porous surface in an enclosed ventilated room and allow it to air dry. A greenhouse is an ideal place to air-dry pollen. More rapid drying can be accomplished in ovens where a low temperature (100°F maximum) is maintained and a vent is provided for the moisture-laden air to escape. Dry pollen to the point that pellets will not adhere to each other when squeezed. Dried pollen can be placed in airtight glass or metal containers and stored in a cool, dry place.

Fresh pollen can be placed in paper bags and stored in a freezer at below freezing temperatures. Pollen may be kept frozen until it can be dried or until it is used.

Blending fresh pollen in equal parts by volume with soybean flour is possible; store this mixture in sealed containers in a cool dry location. Take care to pulverize the pollen pellets and soybean flour and blend the mixture thoroughly.

MAINTENANCE Remove the grid from the trap every fifth day to allow the bees to replenish their own pollen supply, which they need to maintain the colony. Then, you won't curtail brood rearing and retard the colony's growth.

In humid weather empty the tray every day to prevent the pollen from molding. Even in dry weather, collect the pollen at least every two days.

Remember that it is important to the well-being of the colony to trap pollen only during major pollen flows. The amount trapped will depend on the intensity of the pollen flow.

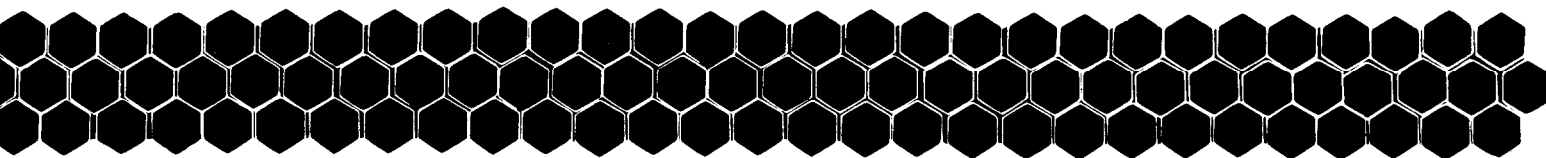
STORING POLLEN

Freshly trapped pollen is perishable and must be frozen or dried. Store it in a deep freeze or dry it in a suitable drier until the pellets don't cake when you squeeze them in your hand. A five-gallon honey can is excellent for storing dry pollen pellets.

TIME TO DIVIDE

If you have successfully overwintered a colony and have started feeding pollen supplement at the end of March, the colony will be strong enough to divide by early or mid-May. Be sure you have an extra queen available. On a warm day take the colony apart. Inspect the brood chambers. If you locate the queen, place her in the first or lower brood chamber with the eggs and brood. You can remove sealed brood and place it in the second brood chamber. Be sure there is pollen and honey in this chamber.

Place the inner cover over the lower chamber. Cover the escape hole with a piece of masonite or fiberboard. Now, place the second brood chamber over the inner cover. You have two separate colonies—one on top of the other. The top one is queenless. Be sure there also is pollen and honey in this chamber and the top auger hole is open. Some beekeepers turn the auger hole entrance so it faces in the op-



posite direction of the first brood chamber. Now place the queen cage in the top unit between the two center frames. Place it at an angle with the candy plug upward. This plug is upward so if a nurse bee dies or is killed in the queen cage her body will not plug the opening and prevent the queen from being released. After several days check to make sure the queen has been released. As a rule you will see eggs. This is the slow release method (Figure 14).

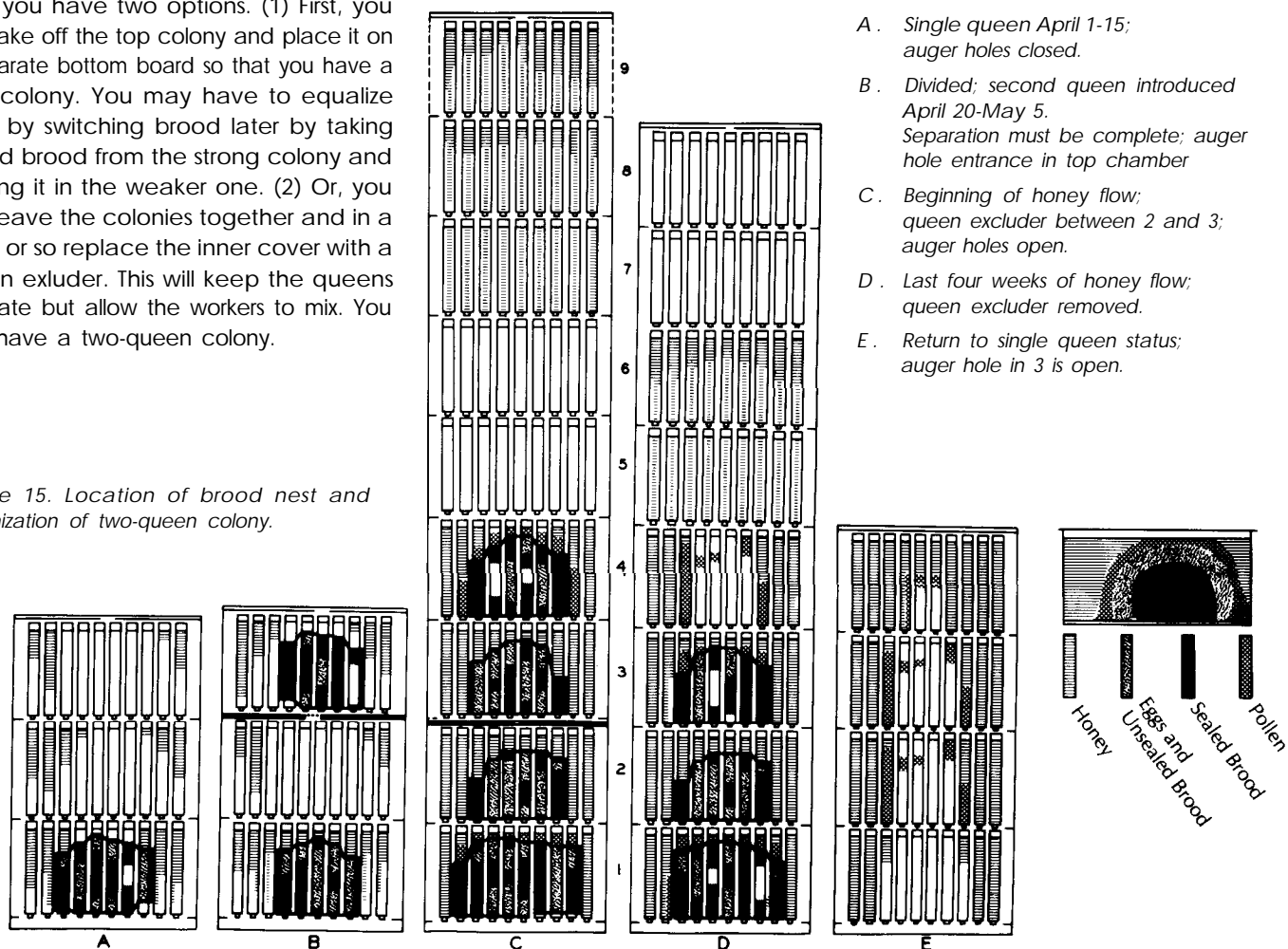
IF YOU CAN'T FOND THE QUEEN

If you are interested in dividing colonies but don't have time to or cannot locate the old queen, you might try the following suggestion. Divide the colony by using the inner cover with the escape hole closed or sealed as described earlier. After one week inspect each chamber. The queen will be in the section that has eggs. The queenless section will be without eggs, or have the beginnings of queen cells. You can introduce your extra queen into this section. Be sure to destroy the developing queen cells.

TWO-QUEEN COLONIES

Now you have two options. (1) First, you can take off the top colony and place it on a separate bottom board so that you have a new colony. You may have to equalize them by switching brood later by taking sealed brood from the strong colony and placing it in the weaker one. (2) Or, you can leave the colonies together and in a week or so replace the inner cover with a queen excluder. This will keep the queens separate but allow the workers to mix. You now have a two-queen colony.

Figure 15. Location of brood nest and organization of two-queen colony.



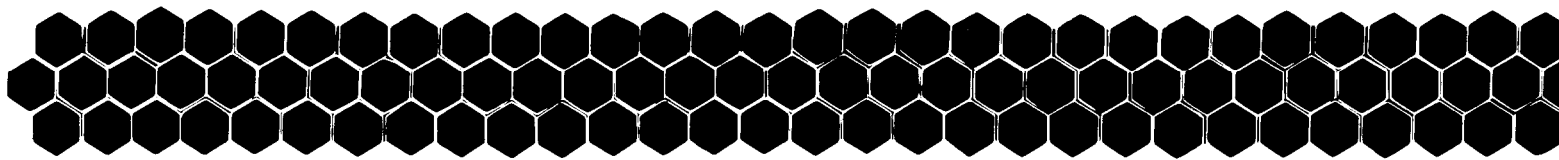
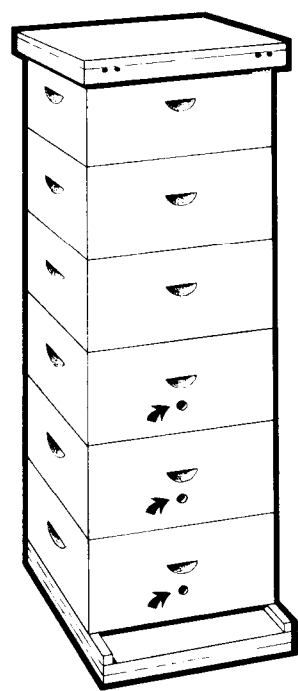


Figure 16. Auger hole entrances (shown open, as during summer)



INCREASE PRODUCTION Experience shows that strong colonies produce more honey than weak or small ones. This is the basis for a two-queen colony. Strong colonies are more efficient not only because of the larger population but also because a much larger percentage of the adult bees are available for nectar gathering. Fewer of them are required to stay in the hive to take care of the brood and other housekeeping chores. For example, a small colony of 15,000 bees produces 25 pounds of surplus honey. But a colony of 30,000 bees produces 68 pounds of surplus honey, and a strong colony of 60,000 bees produces 154 pounds of honey (See Table 1).

Table I. Honey Produced by Various Sizes of Colonies

Bees	Brood	Ratio of Brood/Bee %	Lbs. Honey
15,000	11,850	79	25
30,000	18,300	60	68
60,000	15,000	12	154

These figures show that as a colony increases in population the ratio of brood cells to bees decreases. As the population increases the honey gathering efficiency increases. This is why it is desirable to have the peak population at the beginning of the main honey flow.

AUGER HOLES

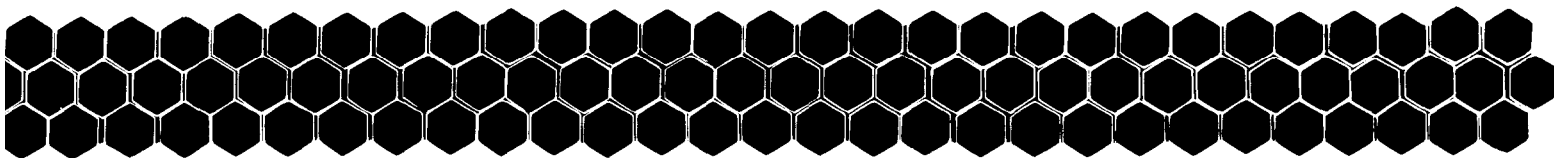
Auger holes increase efficiency. Drilling 1 to 1-1/4 inch holes in the brood chamber is a simple operation that serves several purposes. Bees will use this opening during the main honey flow. The less work bees have to do, the more efficiently they produce honey. Holes also provide ventilation to eliminate extra moisture. The upper hole allows bees to take a short flight on a mild day during the winter. Bees infected with nosema will fly out and may not return, thus reducing the incidence of nosema within the hive. After the honey flow, you can close the upper holes, forcing the bees to use the lower opening and bottom entrance. In late October, restrict the bottom entrance, plug the two lower holes, and leave the top hole open.

SELLING PACKAGED BEES

You might consider selling packaged bees to beginning beekeepers. Experienced beekeepers observe that in late April you can shake two or three pounds of bees from the strong colonies without any loss of production that summer. Obviously, you should also provide the beginner with a queen.

SWARMS

A swarm in May is valuable to the person who can capture it, but represents a serious loss to the colony from which it emerged. Swarming is a natural means by which a colony reproduces, but you can prevent it if you understand what is happening.



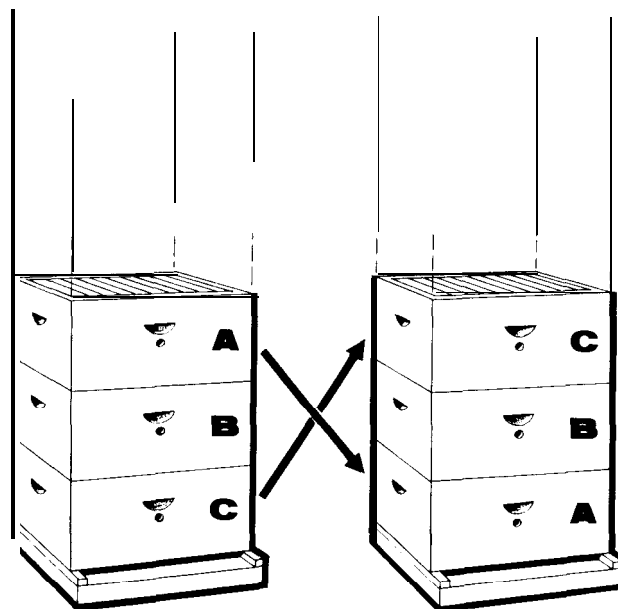
The queen normally works upward within the colony, laying eggs in empty cells towards the top of the brood chamber. Swarm preparation begins when the colony is either crowded with excess bees, or lacks space for brood rearing. By adding another chamber, you can provide extra space and prevent swarming.

REVERSING

Reversing the brood chambers is a technique developed over the years (See figure 17). The reason for it is quite simple. The lower chamber will have either empty cells or sealed brood. As these bees emerge from sealed cells the cells will be cleaned and readied for the queen to lay eggs. Eggs and sealed brood placed in the lower chamber won't be abandoned, but will draw bees downward. Reversing about every 10 days will keep the queen and bees working at capacity at least until the beginning of the honey flow. By reversing you can keep the queen in the lower part of the hive, and you won't need to use a queen excluder.

Experienced beekeepers watch for eggs and queen cells during reversal. Finding eggs suggests the queen is present and laying, so it is unnecessary to inspect each frame or hunt for the queen. If you are sure your queen is laying and see eggs or developing larvae in queen cells, be sure to destroy them. If you allow these larvae to develop, your colony will swarm. If you find queen cells but no eggs, the queen is either failing or missing. You now have several options. You can re-queen with a spare or extra queen from a nucleus. Or, you can unite this queenless colony with another colony. Or, you can let nature take its course and allow the queen cells to develop and produce a new queen. In northern climates, early spring is a risky time for producing your own queen. While a queen can be produced, good queen mating weather must be synchronized with queen emergence. Drones must be available and the weather must be warm enough for flight within five days after queen emergence. Cold or rainy spells during this period can spell disaster.

Figure 17. 'Reversing around the middle'



Experienced beekeepers watch for eggs and queen cells during reversal. Finding eggs suggests the queen is present and laying, so it is unnecessary to inspect each.

DRIFT

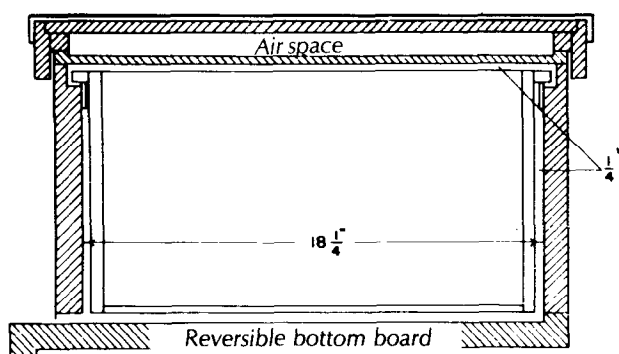
Bees are known to drift considerably within an apiary. They drift less between two colonies placed side by side than between those colonies similar in appearance but in different locations. Placing colonies far apart does not always stop drifting. Strong winds from one direction cause bees to drift to one side of the yard during spring flights. Young bees often drift to other colonies during their "play flight." Bees will drift from weak colonies to stronger colonies by following the greater flight of bees. Bees going out to orient themselves, and especially packaged bees, may follow bees from an established colony. We have observed that if there are four rows of colonies in a yard, the two center rows often have fewer bees and produce less honey than the front and rear rows. Obstacles such as trees or bushes in front of the colony may cause returning bees to drift to other colonies to avoid them. You can equalize to some degree the strength of colonies by taking brood and attached bees from the strong colonies and placing them in the weaker colonies. Keep bees' habits in mind when designing your yard.

July and August

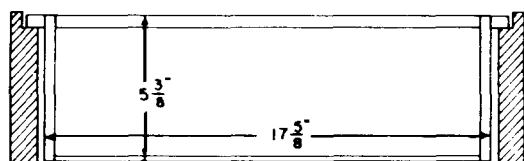
HONEYFLOW

July is the honey flow month. If you build strong colonies during May and early June, your payoff will come during July. As soon as combs are two-thirds to three-quarters sealed, you can remove them to extract honey. Commercial beekeepers generally remove filled and fully-sealed supers. You might use nine frames in a ten-frame super. This will result in thicker combs. Don't leave too much space within a super. Bees will build combs in this area. Thicker combs are easier to uncap.

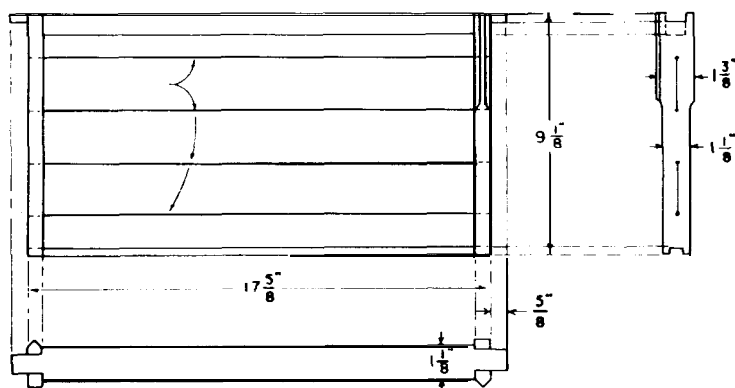
Figure 18. Plans and dimensions for a 10-frame beehive.



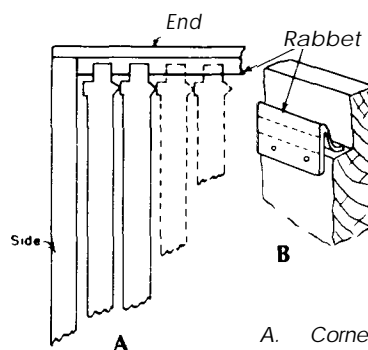
Cross Section of Hive Body and Frame



Cross Section of Shallow Super

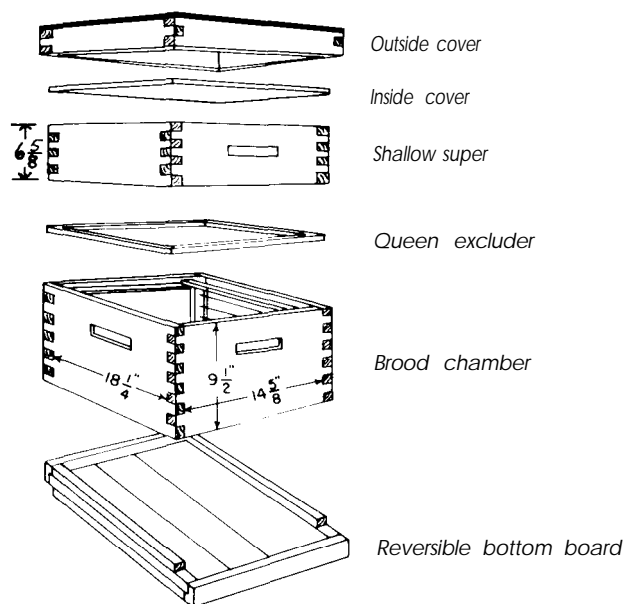


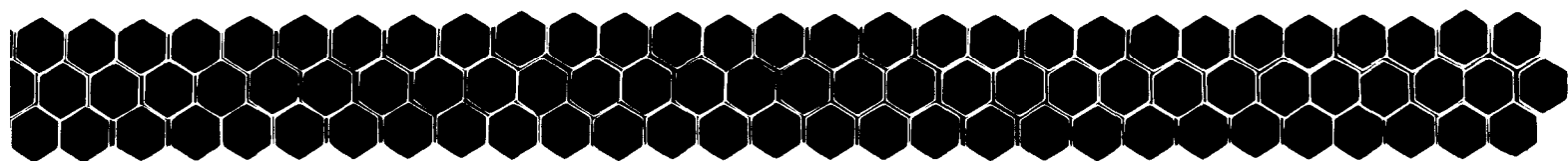
Side, End, and Top Elevation of Frame



A. Corner of 10-frame hive body, showing construction and position of frames

B. Part of end of hive body, showing rabbet, which could be made of tin or galvanized iron





BOTTOM SUPERING

You will have to add extra supers to strong colonies. You can lift off filled, uncapped, and partially filled supers. Then add an empty super and place the uncapped or partially filled super on top. Even though this is more difficult to do if the hive is eight or ten supers high, it does improve the efficiency of the hives. Don't remove honey before it is 75 to 80 percent capped. Unsealed honey does not have all the water evaporated and either could be below sugar analysis if sold or ferment if stored at home.

REMOVING SUPERS

There are several ways of removing honey from colonies of bees. You may want to brush individual frames with a soft brush and place them in a covered box or empty super to be hauled for extraction.

Some beekeepers like to use bee escapes. These work well if the equipment is tight. Several repellants are also available from commercial bee supply houses. At temperatures below 60 to 75°F benzaldehyde or acetic acid plus smoke work best. At temperatures between 80 and 95°F propionic anhydride or butyric anhydride works best. Bee supply firms sell these materials under various trade names. These products won't harm the bees or impart an odor to the honey.

If you have a larger operation, you might consider blowing bees out of the supers with air. Good blowers are on the market, and an industrial vacuum cleaner in reverse, hooked up to a portable electric generator also works well. Or, you might use a combination of repellants and blowers.

Toward the end of the honey flow, be sure not to leave supers or honey exposed because bees will start to rob from them. Once this starts, it is difficult to stop.

TRAPPING POLLEN

This is a good time to trap pollen. See pages 11-14 of this publication for instructions.

September – December

At the end of the main honey flow many vigorous colonies may have light brood chambers because the bees moved all the incoming nectar up to the top supers. In early August it is desirable to close the entrance holes in the upper brood chambers. This forces the bees to enter at the bottom board where they are more likely to rear brood and fill the lower chambers with incoming nectar from fall-blossoming plants.

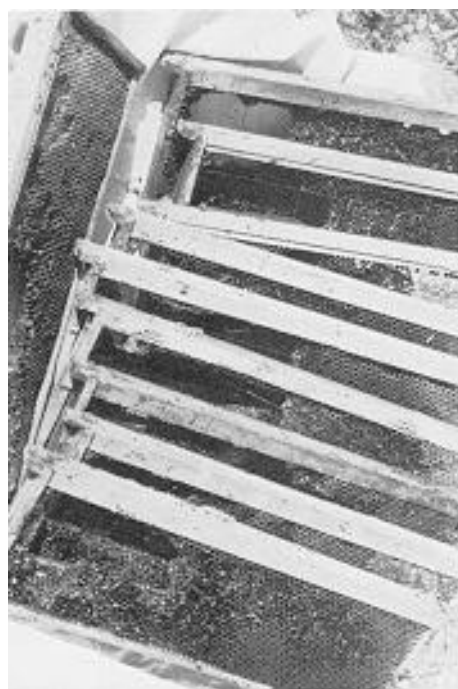
FILL THE BROOD CHAMBERS

You will have wet unsealed and partly filled combs. The bees will clean and carry this honey into the brood chambers if you place the inner cover over the brood chamber. Now, place the combs you wish to have cleaned or emptied on top of the inner cover. Bees will clean and carry all the honey down. If you have an unsuspected honey flow late in the season, the bees will carry the surplus honey back up into the supers through this escape hole. Used in this manner, the inner cover will work as a good safety valve.

Now is the time to prepare for winter. Consider wintering only your best colonies. You should have 70 to 80 pounds of honey in each one. If you don't have all dark combs consider placing several dark combs with honey and pollen in the center of the brood chamber. Bees prefer to cluster on dark combs. Distribute pollen and honey from the weak colonies to the strong colonies. Remember, bees are not going to eat too much. They use only what they need. If they run short, they will starve.

Feed sugar syrup (2:1 mixture) to all light colonies until they have 70 to 80 pounds of reserve food. you can use the division board or pail feeders. What is inside of the hive is now very important.

FINALLY, reduce the size of the bottom entrance or close it with hardware cloth so mice cannot enter the hive while bees are clustered. Also provide an opening (auger hole) in the top hive body so excess moisture is able to escape.



Mouse damaged brood comb.

Problems

BEE DISEASES

Like all living things, bees can get diseases. You need to know what to look for and how to identify problems early. Beginning beekeepers may confuse insecticide kill, chilled brood, starvation, and drone slaughter with diseases. Learn to recognize virus and fungus diseases for which there are no controls, so you can distinguish these from bacterial and protozoan diseases which are controlled with drugs. This publication describes three curable bee diseases in the following sections. For specific problems, other specialized publications are available from your county Extension office. One of these is *Identification and Control of Honeybee Diseases*, FB 2255, published by the US Department of Agriculture.

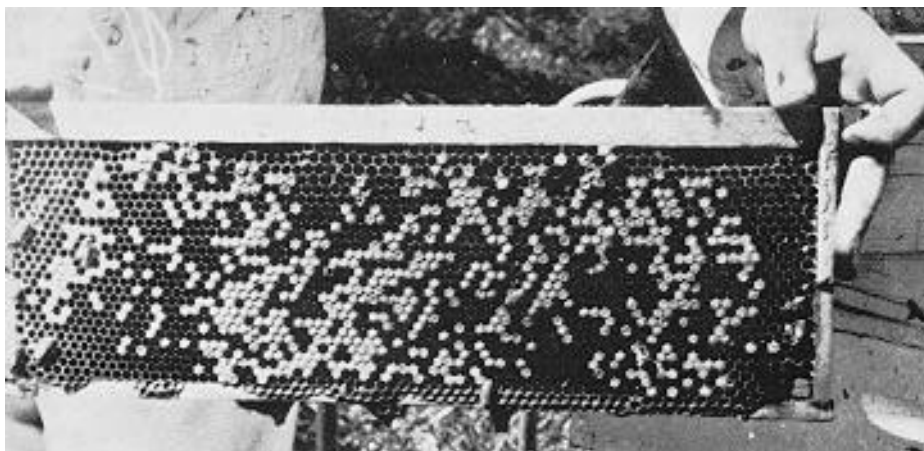
NOSEMA

The organism causing this disease is a one-celled animal (a protozoan) *Nosema apis*. This organism is widely distributed in nature and also is found in wild bees. You can assume nosema is present in your colony. It lives in the lining of the intestine of the adult bee. During growth this pathogenic organism destroys the lining, shortens the life, and sometimes causes dysentery. The nosema organism multiplies by producing spores which accumulate in a bee's rectum and are voided with its excreta. During summer bees usually defecate outside the hive, naturally reducing infection within the colony. However, in the winter bees don't fly outdoors so they soil the comb. Other bees attempt to clean this, become infected, and spread disease.

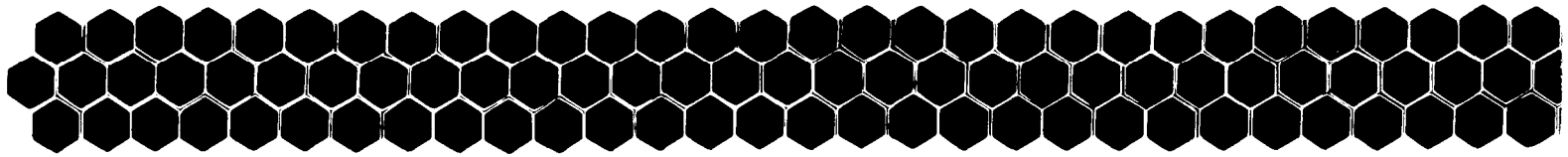
Nosema spores remain viable on combs for months, but some fumigants and heat will destroy them. During spring expansion the disease again can spread when healthy bees become infected by picking up spores when cleaning the soiled comb.



In early spring such soiling on the outside of a colony suggests that it may be suffering from nosema or dysentery.



Brood comb showing diseased brood. Note some caps on the cells appear sunken, and some have small puncture holes. The uncapped cells may contain dead unsealed larvae.



TREATMENT The drug fumagillin (Fumidil B) is effective in reducing infection of nosema. Fumidil B is a dry powder which readily dissolves in cold water. First, dissolve the amount you intend to use in a small quantity of cold water, then add this mixture to the cold (2:1) sugar syrup and stir. Fumidil B will not dissolve readily in sugar syrup. This drug is sold in 0.5 gram and 9.5 gram bottles which make, respectively, 5 to 6 or 100 to 120 gallons of medicated syrup.

Suggested treatments are: Newly installed package of bees, 1 gallon medicated syrup. Fall treatment, 2 gallons medicated syrup. Overwintered colonies, early spring treatment, 2 gallons medicated syrup. No medication should be given to bees immediately before or during the honey flow.

The fall treatment will reduce infection in overwintering bees, which will store the excess medicated sugar syrup in the brood area to benefit the winter cluster. The spring treatment gives protection to workers cleaning soiled combs to accommodate the expanding cluster.

Queens also can become infected with nosema. Infected queens die or are naturally superseded during the spring or early summer. Feeding Fumidil B at requeening time or when installing packages will greatly improve a colony's performance.

BROOD DISEASES

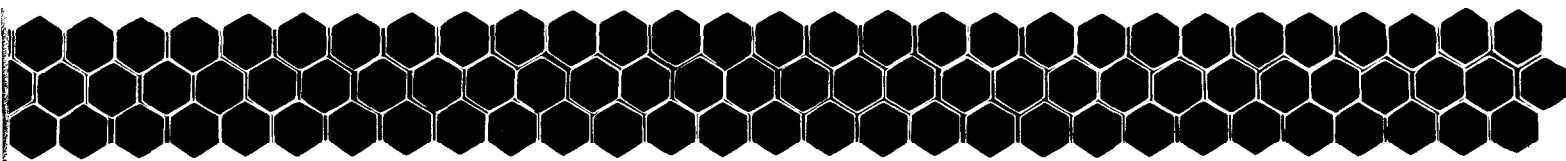
Two controllable diseases, American and European foulbrood, can infect bee larvae. Even though adult bees are resistant to the diseases, the colony is weakened since old bees are not replaced by new ones. In past years burning was the only method of controlling one of the foulbrood diseases. This was required by law. Now, with the proper use of drugs a beekeeper can control these diseases without burning. Most states have retained the burning law but use this only as a last resort, or when a beekeeper refuses to cooperate with regulatory officials.

American foulbrood is caused by bacterial spores spread through honey or on equipment. Two common ways of getting American foulbrood in your apiary are to exchange or buy equipment (supers, combs, frames, etc.) or by robbing. Bees will rob a weak colony which is likely to be diseased. They will carry the honey remaining in a weakened colony along with the pathogenic organisms to their healthy hive.

Good management will help keep these diseases to a minimum. If you buy used equipment, be sure it is disease-free. Many states require inspection before moving bee equipment. Don't feed your bees honey you purchased at a store or from a fellow beekeeper; it could contain disease organisms. While these bacteria don't affect people they will infect your bees.

Although there is little you can do to prevent your bees from robbing an infected bee tree or an abandoned colony, you can reduce the chance of spreading disease within your own apiary by preventing robbing. Do this by closely examining weak colonies for disease, uniting them with other stronger colonies and reducing the colony entrance. Bees more easily can defend their hive if the entrance is small.

Oxytetracycline (Terramycin) is effective and approved for use on both diseases. Special publications are available giving the description and identification of the diseases and ways of treatment. The following is a treatment summary.



AMERICAN FOULBROOD Treatment: Gorge the colony three or four times at four to five day intervals with the following: Terramycin (TM-25), 3.27 grams in each gallon of heavy sugar syrup (1 level teaspoon = 4 grams so use about 4/5 level teaspoon per gallon). Dry formulation treatments: Terramycin-powdered sugar dry formulation by mixing one part TM-25 with four parts of powdered sugar and apply 1/2 ounce of the mix per colony to the top bars at each of three treatments spaced four days apart.

EUROPEAN FOULBROOD Treatment: Gorge colony three or four times at four to five day intervals with the following: Terramycin (TM-25), 3.27 grams in each gallon of heavy sugar syrup (1 teaspoon = 4 grams or use about 4/5 level teaspoon per gallon).

INSECTICIDES AND BEES

Insecticides will kill bees. Often, the use of insecticides isn't compatible with beekeeping. Other times, only a little understanding and consideration are needed to protect everyone's interests.

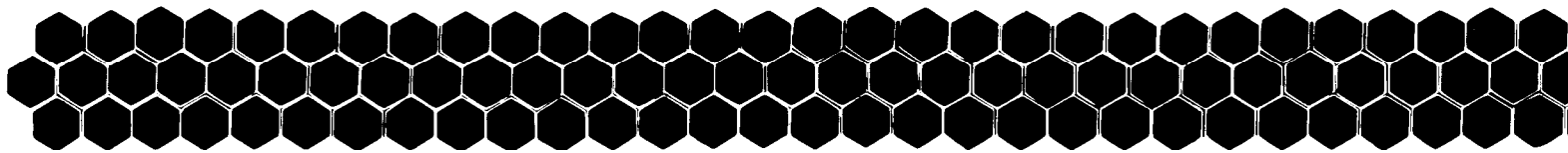
A farmer violates the law if he applies an insecticide, and it drifts over someone else's property. The applicator is liable for damages and even may be assessed for other penalties.

On the other hand, a person raising crops has a right to protect his investment. In most situations it is not necessary to apply insecticides when his crop attracts your bees. It's important to remember that bees are wild and cannot be confined.

THE PROBLEM WITH INSECTICIDES Colonies can be killed easily if they are accidentally, inadvertently, or through ignorance sprayed with an insecticide. But a colony has several behavioral traits which help guard against massive poisoning from the field. Old workers forage for nectar and pollen. While any worker killed in the line of duty represents a loss to the colony, losing an old worker is not as damaging as losing a young worker. Foraging workers poisoned in the field seldom return to the hive. Even those contacted with a slow-acting insecticide tend to become disoriented and get lost; even if they did return, the guard workers probably would not admit them because of a "foreign" odor.

A spray to a single field may not be disastrous to a colony, but seldom is only one field in an area treated. So, a colony may lose its foragers in nearby fields on successive days. The end result is a seriously weakened colony.

A far more serious type of poisoning occurs when pollen is contaminated with an insecticide like carbaryl (Sevin). It is a relatively safe product because of its poor penetrating characteristics, but a very effective insecticide especially when ingested by insects. Honey bees which gather pollen from treated fields are not affected by the spray, but workers in the hive who eat the contaminated pollen are killed. Instead of losing one old worker out in the field, the colony now may lose several to possibly 100 young ones in the hive. In serious poisonings, a large number of workers accumulate around and inside the hive. If the queen survives, she usually stops laying, and unsealed brood starves without enough workers to feed them.



Corn is a wind-pollinated plant, and under normal circumstances honey bees will visit it only if no other source of pollen is available. The crop can be safely sprayed when other more attractive plants are blooming or if the spray is directed at the ear, rather than the entire plant. Corn produces pollen in the morning; generally, afternoon spray applications are less damaging.

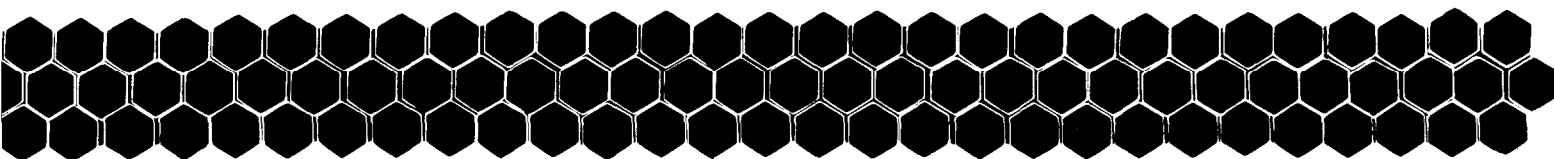
CONFLICTS OF INTEREST Conflicts sometimes arise between beekeepers and corn growers. Most sweet corn must be protected from corn ear worm and sometimes corn borers. Insecticide applications also must be timed precisely so that the chemical kills the larvae before it penetrates the stalk or ear. Sweet corn for processing usually is grown in concentrated areas near processing factories. The flight pattern of one apiary may be over 2 to 5 different farms. Each field may have a different maturation date, requiring a different treatment schedule. Some farmers apply their own insecticides, but many hire custom applicators using either aircraft or ground machines. Losses can be reduced if ground equipment is used, and the spray is directed at the ears. However, there are times when ground equipment cannot be used because of rain or wet fields. Wind may delay application for a time, so aircraft are used to "catch up." Under such circumstances, beekeepers can expect losses if honey bees were foraging on corn.

Beekeepers can take precautions in limited situations by covering or moving hives. However, the same hive may have workers in several fields, so they may have to be covered several times a week, which is impractical.

The most serious, and often highly emotional, conflicts arise between the part-time and/or hobby beekeeper, and custom applicators in heavily settled areas. In some areas there are a large number of hobby beekeepers, and honey bees are very important to them. Assuming the flight range of two miles, one custom applicator may be applying insecticide over the flight range of 3 to 10 or more hobby beekeepers.

ENCAPSULATED INSECTICIDES Some insecticides have unique penetrating powers, being nearly as toxic to organisms (and man) on the skin as if ingested. Some insecticides hydrolyze (react with water) rapidly and result in a number of harmless materials. For this reason, some potent insecticides can be applied to food crops and after a specified waiting period, the sprayed crop is free of the insecticide and safe to eat.

A technique of encapsulation has been discovered and patented. In theory, the process is simple. Divide the chemical into very small particles and coat each one with a non-toxic substance such as plastic or gelatin. This process solves two problems associated with insecticides. It reduces the hazard associated with highly toxic, rapidly penetrating substances, and it controls the rate of hydrolysis. A highly poisonous substance such as methyl parathion has been made 6 to 12 times less toxic to people than conventional methyl parathion. However, when encapsulated methyl parathion is applied to corn it behaves somewhat like carbaryl. It is carried into the hive on pollen, and the end result is similar-numerous dead honey bees. Conventional methyl parathion normally would kill only the field workers, damaging the colony less severely.



REDUCING LOSSES In some instances, farmers and custom applicators can help reduce colony losses by choice of product. Products may be classified into highly, moderately, or slightly toxic categories. But a highly toxic product may have a short residual life so a highly toxic substance, in some circumstances, may be used safely and other times it may be highly detrimental to nearby colonies. Formulations known to be hazardous might be avoided, even though they are more economical. For example, as a rule, dusts are more hazardous to honey bees than liquid sprays.

Special circumstances related to the crop should be taken into consideration. Carbaryl is a safe product, but highly hazardous when applied to corn because it can be carried to the hive on pollen. In this case more hazardous products such as diazinon or parathion might be substituted. Workers in the field will be killed, but the colony will be spared. You may need to incorporate other management techniques into the total program. If the cover crop in an orchard is visited by honey bees and it is necessary to spray trees, mowing or discing the crop may reduce or eliminate the problem. Make pesticide use decisions on a professional basis, considering all the interrelated factors.

Beekeepers also can take precautions to reduce losses. When small numbers of colonies are involved, confining the workers for one or several days is possible, provided precautions are taken to prevent overheating. Adding an extra empty hive body which provides more space, or covering the colony with wet burlap will help keep the colony cool. Replacing the top cover with a wire screen might help prevent overheating. Beekeepers engaged in pollination services are in a position to move from the immediate area.

Perhaps more is written and reported on the insecticide-honey bee problem than on any other subject involving honey bees. Some groups and individuals advocate outlawing, banning or severely restricting specific insecticides, regardless of consequences to other segments of the agricultural economy. Still others totally disregard the rights of the hobby beekeeper, insisting that honey bees are trespassers and should suffer the consequences unless they are specifically brought in for pollination. As mentioned previously, this is not a new problem, and conflicts of interest are seldom resolved to the complete satisfaction of the involved parties. Those beekeepers residing in heavily agricultural areas will have to accept the fact that on occasion colonies may be injured. The insecticide user will be confronted with more stringent regulations, which tend to restrict his choices. Those not able to comply will be forced out of business.

Laws, rules and regulations are frequently revised or changed. If you have questions related to the current status of pesticides and their application, contact your county Extension office.

Honey Handling

Bees cap honey after it is properly aged and the moisture content is reduced. You can safely remove frames of honey for extracting after 75 to 80 percent of the cells are capped. If you are producing comb or chunk honey, you may want to have them completely capped, but you should remove the sections or frames as soon as they are capped; otherwise, the comb will be discolored by "travel stains."

Honey is a fine food product and should be handled as such. Protect it from dirt and dust at all times. Keep combs and supers tightly covered, so bees don't start robbing. If honey production is more than just a hobby, your honey house or honey handling area should conform to public health regulations related to food processing industries. Contact local health or food inspectors for specific details.

Uncapping and extracting should be done in a warm room (70 to 90°F). If the honey supers are cold, as they might be in the fall, you may have to place them in a warm place (70 to 95°F) for about one day before extracting.

During extraction, bits of wax and other extraneous matter will be in the honey. Strain the honey through a fine screen (about 90-mesh). A double layer of cheese cloth also works well. Straining proceeds faster if honey is warm (about 90°F). After straining, you can heat honey to approximately 140°F and bottle it. Do not overheat honey. It will begin to darken, and you may lose some of the delicate flavor and aroma. Honey can be sold raw, that is strained but not heated.

Food marketing regulations vary from state to state. Check with knowledgeable authorities on specific details before making a large investment.

There are also federal honey grades established by the United States Department of Agriculture in cooperation with the honey industry. If you desire to market your honey using federal grades, your State Bee Inspector or University Extension office usually can put you in contact with the proper regulatory officials.

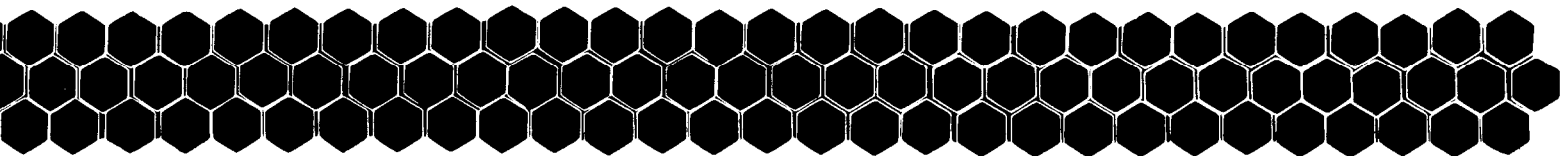
Most states permit the sale of ungraded honey, provided it is properly labeled. Containers and container labels also are regulated. They usually will conform to most state and federal regulations if you purchase them through a reputable bee supply dealer.

Most honey will crystallize under certain conditions. Some years honey crystallizes quickly, other years, very slowly. Heating honey to 140°F before packaging delays crystallization, as all the microscopic "seed crystals" are dissolved. Crystallized honey can be restored to a liquid by heating (not over 150°F).

Bees wax is valuable by-product. The cappings can be warmed to 150°F, and the honey separated from them by straining. You can also heat the mixture of wax and caps to about 150°F. The wax will float. After cooling you can lift off the wax.

You can melt bees wax in hot water and then allow it to solidify. There will be impurities on the bottom of the wax cake. These impurities (slum gum) can be separated from the wax cake. If you have large quantities of slum gum and old, broken unusable combs, you can send them to a bee supply house for processing. They will extract the wax and pay you for it.

Honey is a complex mixture. The chemical and physical properties, as determined by the United States Department of Agriculture laboratory, are listed on the following page.



HONEY AND BOTULISM In September, 1978, an article in "Science" associated some cases of sudden infant death syndrome (SIDS) with botulism poisoning. Sudden infant death syndrome has long puzzled the medical profession. Some estimate as many as 10,000 infants, less than one-year old, annually die from this problem.

Botulism is a non-infectious but often fatal disease in adults, yet apparently some infants are able to recover from this disease. In adults, this disease is brought about through food poisoning. The bacteria (*Clostridium botulinum*) are a spore-formers found practically everywhere in the environment. They are harmless when injected along with dust or dirt on raw fruits and vegetables. However, when these spores grow, as in improperly canned non-acid food, they produce an extremely toxic chemical.

Recent studies suggest the intestines of infants differ from adults, and the botulism-producing spores germinate and begin to grow in a child's intestine. Some speculate that natural inhibitors may not be present in an infant's intestine. Based on animal studies in laboratories, it is estimated that as few as 2000 bacterial spores could produce enough toxin to kill a 15-pound child. Studies in California found that 30 percent of the infants hospitalized for botulism poisoning were fed honey before becoming ill. But the same study mentions that 10 who died were not fed honey. Honey samples were analyzed and it was determined that between 10-15 percent contained spores of *Clostridium botulinum*. These spores survive several hours of boiling water. For that reason, pressure cookers are required when canning certain non-acid foods and meats, and other meats are preserved with sodium nitrite.

There is no practical way to remove or inactivate these spores from honey, so the logical and reasonable approach is to avoid feeding honey to infants less than one-year old. Documented problems occurred in children less than 26-weeks old. This suggestion dramatically differs with information contained in articles and books written prior to this 1978 report. In fact, some books extoll the merits and virtues of feeding honey to babies less than one-year old.

B E E K E E P I N G R E C O R D S

Accurate records are essential if you intend to make a good business management decision. Publication A2655, Beekeeping Records, uses standard accounting procedures and terms so it is useful for business analysis and tax purposes. Record sheets in this publication cover a three-year period so you can accurately analyze your operation and compare results from one year to the next. Space is also provided for biological and operational notes.

Table 4. Physical Properties of Average Honey

One pound (453.9 g.) of average American extracted honey would contain the following materials:		
Principal Components ¹	Percent	Grams
Water (natural moisture)	17.2	78.0
Levulose (d-fructose; fruit sugar)	38.19	173.2
Dextrose (d-glucose; grape sugar)	31.28	141.9
Sucrose (granulated, cane, or beet sugar)	1.31	5.8
Maltose and other reducing disaccharides	7.31	33.2
Higher sugars	1.50	6.8
Total sugars	79.59	381.0
Acids (gluconic, citric, malic, succinic, formic, acetic, butyric, lactic, pyroglutamic, and amino acids). Total acid, calculated as gluconic acid	0.57	2.6
Proteins (nitrogen x 6.25)	0.26	1.2
Ash (minerals: potassium, sodium, calcium, magnesium, chlorides, sulfates, phosphates, silica, etc.)	0.17	0.8
(Principal Components) Total	97.79	443.6
Minor Components ²		
Pigments (carotene, chlorophyll and chlorophyll derivatives, xanthophylls)		
Flavor and aroma substances, (terpenes, aldehydes, alcohols, esters, etc.)		
Sugar alcohols (mannitol, dulcitol)		
Tannins		
Acetylcholine		
Enzymes:		
Invertase (converts sucrose to dextrose and levulose)		
Diastase (converts starch to dextrins)		
Catalase (decomposes hydrogen peroxide)		
Phosphatase (decomposes glycerophosphate)		
Inhibine (antibacterial substance)		
Vitamins (thiamine, riboflavin, nicotinic acid, vitamin K, folic acid, biotin, pyridoxine - in small and variable amounts)	2.21	10.0
TOTAL	100.0	463.6

Specific Gravity $\frac{68^{\circ}}{68^{\circ}} F (\frac{20^{\circ}}{20^{\circ}} C) = 1.4225$, corresponding to:

81.25 Degrees Brix at 60° F.
43.19 Degrees Baume (Modulus 145) at 60° F.
84.6 Degrees Twaddell
1 gal. weighing 11 lb., 13.2 oz. av.
1 lb. having volume of 10.78 fl. oz. (318.9 ml.)

Caloric Value

1 lb. = 1380 calories
100g. = 303 calories
100 ml. = 432 calories
1 tbsp = about 60 calories

Refractive Index

1.4935 at 68° F. (20° C.)
1.4924 at 77° F. (25° C.)

Vapor Pressure

Corresponding to atmosphere of 60% R.H. at 68° F.

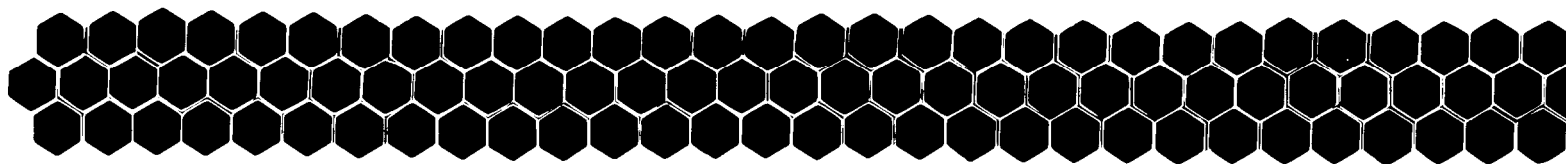
Thermal Characteristics

Specific heat 0.54 at 20° C.
Thermal conductivity at 21° C. 12.7 x 10⁻⁴ cal./cm. sec. °C.
Thermal conductivity at 49° C. 13.6 x 10⁻⁴ cal./cm. sec. °C.

Sweetening Power

Honey sugars have approximately 25% greater sweetening power than cane sugar. Therefore:

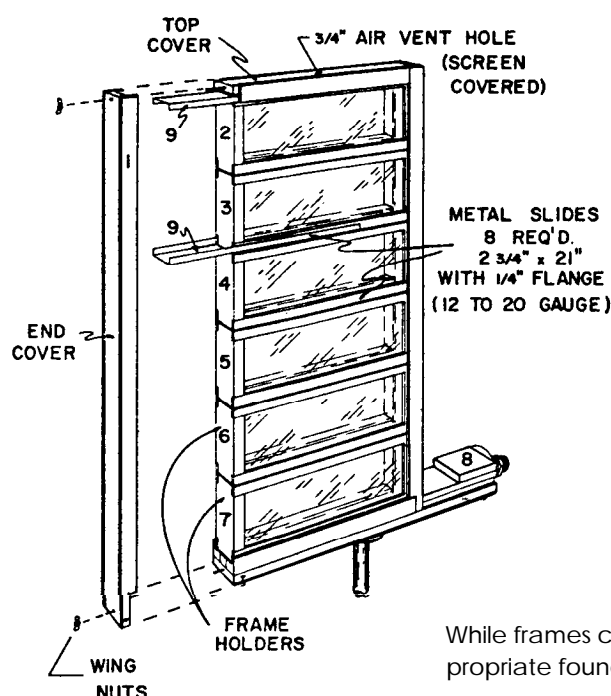
1 gal. average extracted honey (about 9 lb. 6 oz. total sugars) is equivalent to about 11 lb., 12 oz. granulated sugar.
1 volume honey is equivalent to about 1.67 volumes granulated sugar.
1 lb. average honey (containing about 17% water) is equivalent to about 0.95 lb (15.25 oz.) granulated sugar.



WATCH BEES WORK BY BUILDING AND OPERATING AN OBSERVATION BEEHIVE

An observation bee hive can provide you with an interesting, educational and entertaining exhibit in classrooms, clubhouses in parks and campgrounds, or your place of business. Once installed it requires minimal care or maintenance.

Figure 19. Perspective.



The type of hive* described in Figure 19 is unique in that conventional observation hives must on occasion be dismantled and the components readjusted. This hive's component parts (frames) can be manipulated indoors without loss of bees.

If this is your first experience working with bees, you might want to ask a beekeeper to help you get started. Hobbyist beekeepers are generally willing to share their experiences and offer suggestions or even assist you in getting started.

You can purchase a queen and bees from commercial sources. It is much simpler, however, if you obtain a marked queen and frames containing brood and honey from a beekeeper. We describe both methods of starting an observation beehive.

CONSTRUCTION AND LOCATION Anyone with a home workshop can make the observation beehive shown in Figure 19. Use acrylic plastic (Plexiglass or Lucite) rather than glass because it will not break. Plans are drawn to use the standard 6-1/4 inch shallow frame. You could use other size frames with appropriate adjustments.

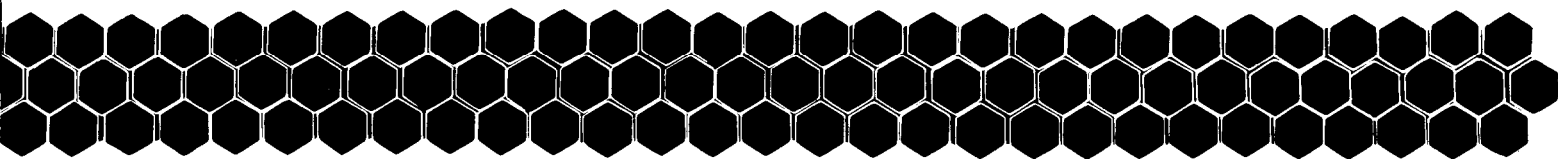
While frames can be made in a shop, you can purchase them along with an appropriate foundation from a bee supply house.

It is important to use well-seasoned wood, and make construction exact in order to avoid escape openings for the bees. The frame holders (Figure 24) should be interchangeable, so they must be identical. The illustration suggests the hive rest on a pipe (Figure 21). This allows flexibility, so the hive turns on the threads. Provide a stop so the union does not separate.

The height is adjustable to suit the needs of your audience or viewers. Locate your outside opening so it won't interfere with people, especially small children. Also avoid open doors, windows or sidewalks. A second story window or higher is ideal for the outlet, but is not always possible or necessary. Do not put the hive in direct sunlight. This will cause overheating and probably will kill the bees.

You can install your observation hive in the spring, as soon as day-time temperatures go above 60°F. It is best to install it, however, when fruit trees or dandelions begin to bloom. If bees are installed early, be sure you have enough food (sugar or honey) in reserve so that they don't starve on cold days.

*Designed by the late CL. Farrar, professor and head of Bee Culture Investigations, University of Wisconsin and U.S.D.A.



INSTALLATION FROM AN EXISTING COLONY Three frames of brood and honey are about the optimum amount needed to start your colony. One frame should contain substantial amounts of sealed brood. If you start the hive early, use two frames containing honey—one if later. The third frame can either contain eggs or developing larvae. Include sufficient bees so they can adequately tend the brood and queen. Be sure the queen is laying and is conspicuously marked so she is readily identified by the observers.

Place the frames with bees, brood or honey in the frame holder (Figure 24) and cover them with sheet metal slides (9, Figure 19). Use masking tape to securely fasten the metal slide covers to the frame holder. Normally bees can be maintained in this frame holder for two hours. For longer time periods, use a screen in place of metal slides on one side; otherwise the bees might suffocate. Be sure that this screen is firmly attached to the frame holder with tape or by some other means. Do not place the bees in direct sunlight while holding or transporting.

INSTALLATION First, locate the observation hive exactly where you want it, and check that the opening to the outside is not blocked.

Place the frame in a frame holder with honey in position (7, Figure 19). Then place another frame in a frame holder with sealed brood in position 6, and the frame containing eggs in position 5. While these positions are not absolutely essential, the bees tend to move the honey from position 7 upward. This will open cells for the queen to lay eggs. You will want to keep the queen and the brood in the lower portions of the observation hive. Normally honey is stored in the top of the hive. Place either comb or foundation in positions 4, 3 and 2, and as the population increases, bees will either store honey or the queen will lay eggs in this area.

With the frame holders containing bees in position, the sheet metal slides can be removed. Bees can then mix and spread throughout the observation hive. Secure the end cover (1, Figure 19) in place.

Other Suggestions Masking tape is very handy to have available. You can use it to secure the metal slides (9, Figure 19) or in aligning and holding in line the holders in positions 1 to 7 until the end cover is secured. If these holders are not in line, bees will escape.

STARTING FROM PACKAGED BEES If you start from packaged bees, purchase a queen and about two pounds of bees. Do not attempt this unless you are willing to perform extra work or have had some experience working with bees. Be sure to study the techniques and procedures used in introducing packaged bees.

Procedure Shake the engorged bees into one or two frame holders containing frames and introduce the queen. Either feed the bees sugar syrup and pollen supplement or have honey available.

If no drawn comb is available, you will have to provide a feeding device, such as an inverted bottle with sugar syrup, or a division board feeder. This must fit inside one of the frame holders. If you start with packaged bees it is essential to provide supplemental food, because bees will not be able to accumulate enough stores to carry them over through rainy or cold days in the spring, which may occur at any time.

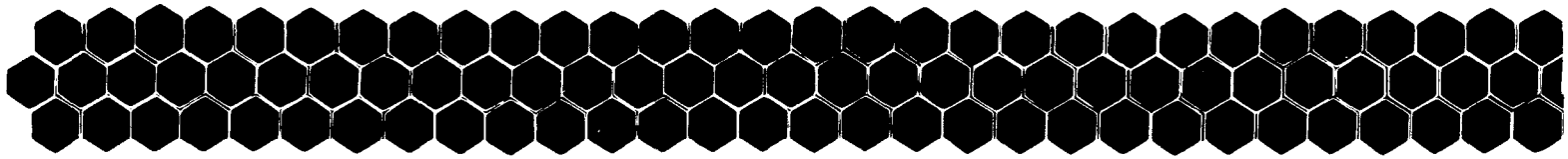
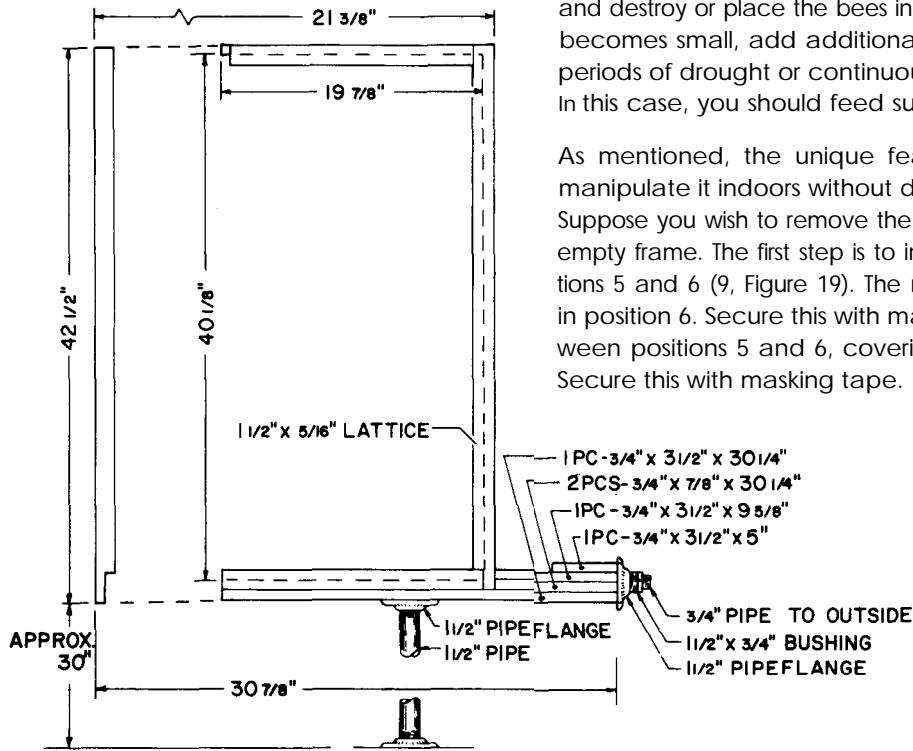


Figure 21. Side view.



Maintenance During Summer and Fall Many variables determine the amount of honey stored in the summer. If the hive becomes too crowded, remove one frame and destroy or place the bees in another colony at least 1/2 mile away. If the colony becomes small, add additional bees, or, if necessary, replace the queen. Long periods of drought or continuously wet, rainy weather results in honey depletion. In this case, you should feed sugar syrup.

As mentioned, the unique feature of the hive in Figure 19 is that you can manipulate it indoors without dismantling. If done properly, no bees will escape. Suppose you wish to remove the bees and frame in position 5 and replace it with an empty frame. The first step is to insert the metal slide (12 to 20 gauge) between positions 5 and 6 (9, Figure 19). The metal slide should close the top of the frame holder in position 6. Secure this with masking tape. Next, insert a second metal slide between positions 5 and 6, covering the bottom of the frame holder in position 5. Secure this with masking tape.

Take the fourth metal slide and insert it between 4 and 5, closing the bottom of the frame holder in position 4. This confines the bees that are in frame holders in position 2, 3 and 4 into that area. The bees are also confined exclusively to the frame holder in position 5, and into position 6 and 7. All that is now necessary is to slide out the frame holder in position 5.

Standard Shallow Frame

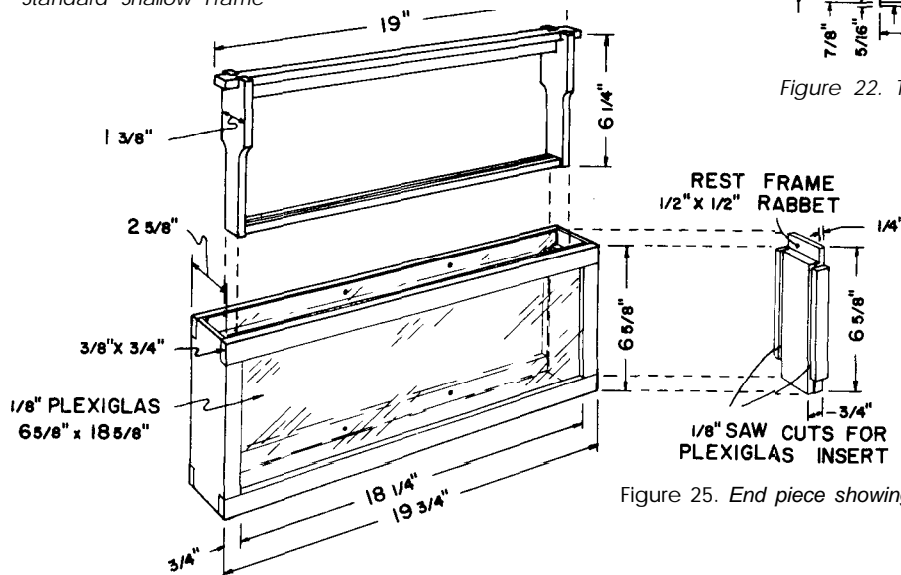


Figure 24. Perspective of frame and frame holder.

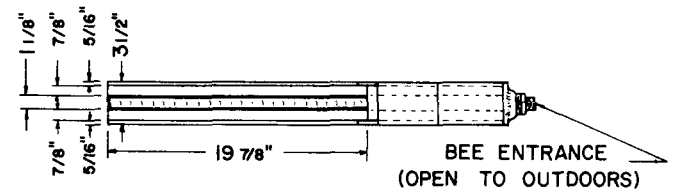


Figure 22. Top view of hive base

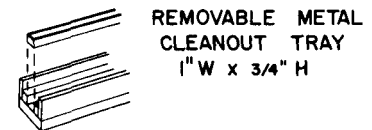


Figure 23. Construction detail bee passage way.

Figure 25. End piece showing saw cuts.

POSSIBLE EXPERIMENTS Once installed and in operation, you can perform a number of observations, manipulations and simple experiments with your hive. Described below are a few: At what temperature do bees begin outdoor flight? How early in the morning and how late in the evening do they fly? Can you tell what flowers are blooming by the color of pollen being carried in?

If you want an end view of comb, cut several drawn combs into sections and install them perpendicular to the length of the frame holder. Space the sections about 1/2 to 3/4 inch apart. In some cells developing larvae may be visible through the transparent side. You might space one or two sections several inches apart. Observe what bees do with that extra space.

You can also perform simple feeding experiments. Place one or several dishes of sugar syrup or honey outside the hive entrance. Do bees prefer sugar water or honey? How much water can you add to sugar syrup before they refuse to feed on it? Add food coloring-does this interfere with feeding? Is it carried back into the hive and where is it stored if carried back? Do bees feed with equal intensity on such artificially placed food sources on warm sunny days when flowers are in full bloom as they do during periods when few flowers are in bloom?

REVERSIBLE OBSERVATION HIVE This observation hive is constructed from acrylic plastic (plexiglass) on a heavy wood base and support. It is designed to use three shallow standard frames. Frames should fit tightly or you should start the hive with frames in the "normal" position as illustrated. Once in operation, bees will build bridge and brace comb to stabilize frames in position.

The top and bottom 1-1/2 inch openings can be used to ventilate and to feed sugar syrup when necessary. A narrow mouth bottle, with one or two small holes (1/8 inch in the cap, inverted into the top opening works well. To the upper inside opening, you can attach a pipe or tube leading outdoors.

The unique feature with this observation hive is when it becomes crowded with honey above the brood area, you can reverse it in place. All that needs to be done is to detach the entry pipe or tube, turn the plastic body 180 degrees on its axis and reattach the entry pipe. You can now watch the bees begin to transfer honey from the lower part of the hive to the space above the brood area, and the queen will continue normal egg laying as if nothing happened.

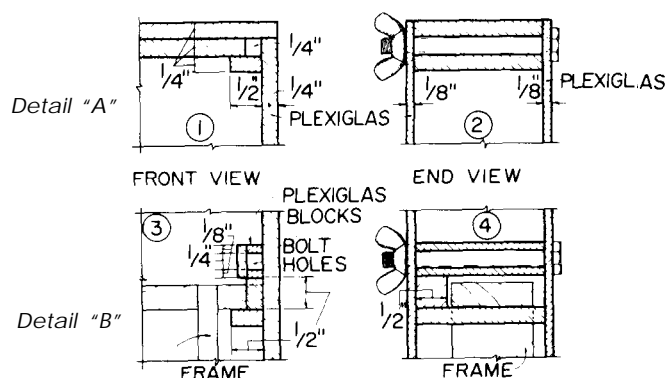
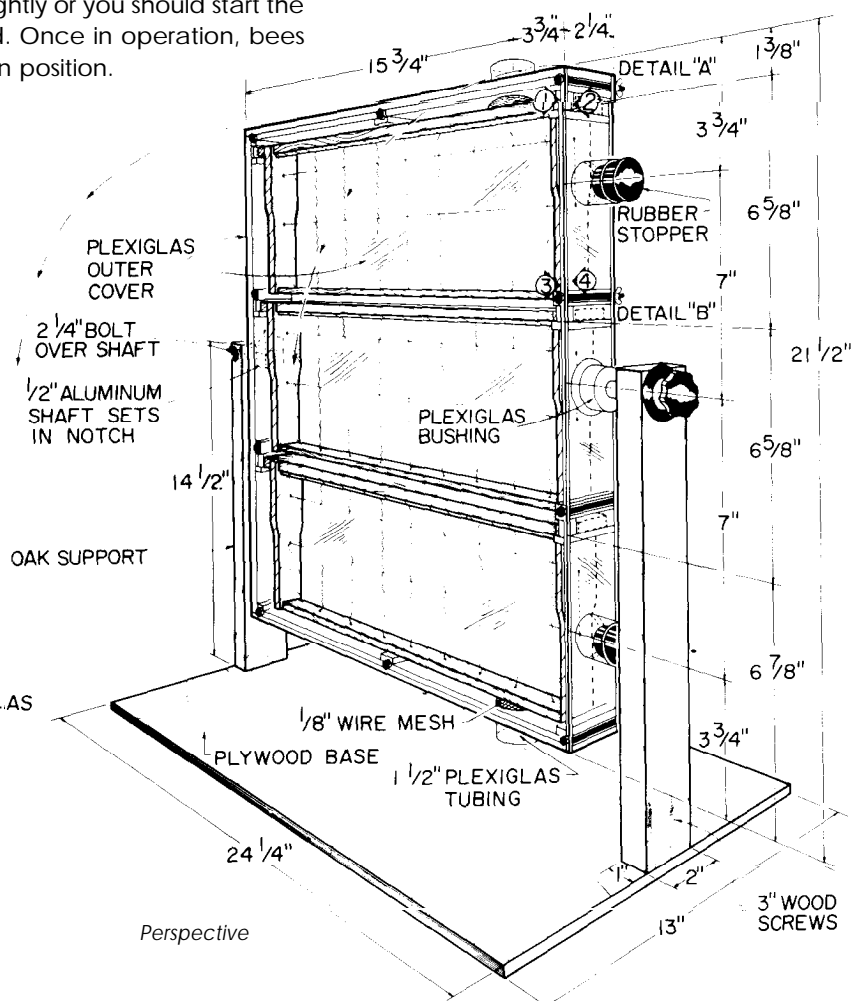
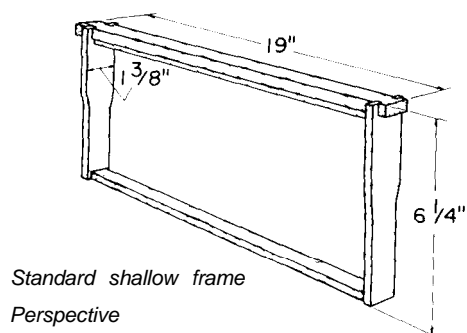


Figure 20.



Additional Information

There are many books, magazines and government publications dealing with bee culture. Listed below are some of the more popular ones that you may find of interest.

Public libraries usually have a collection of popular books on bees. Many libraries have an exchange system so even if a particular book is not in stock, they can obtain it from another library in a relatively short time. Talk to the librarian.

BOOKS ABOUT BEEKEEPING

1. Gojmerac, W. 1980. *Bees, Beekeeping, Honey and Pollination*. AVI Westport CT. Textbook written for vocational school students and hobbyists.
2. USDA. 1980. *Beekeeping in the United States*. USDA Handbook 335. Presents an overview of beekeeping in the United States—Little specific information.
3. ABC-XYZ 1979 of *Beekeeping*. A. I. Root Co. An encyclopedia for the professional beekeeper.
4. Grout, R. (Ed.) 1975. *The Hive and Honey Bee*. Dadant & Sons, Inc. Comprehensive book written for the professional beekeeper.
5. Morse, R. A. 1975. *Bees and Beekeeping*. Cornell Univ. Press. Ithaca, N.Y. A college textbook.

BOOKS ABOUT HONEY

1. Gojmerac, W. L. 1981. *What You Should Know About Honey*. Eureka Valley Enterprises. Madison. Soft-cover book describing all phases of honey production and handling.
2. Crane, E. 1975. *Honey. A Comprehensive Survey*. Russak & Co. N.Y. This encyclopedia-type book covers subject on a world-wide basis.

GENERAL TEXTBOOKS ON HONEY BEES

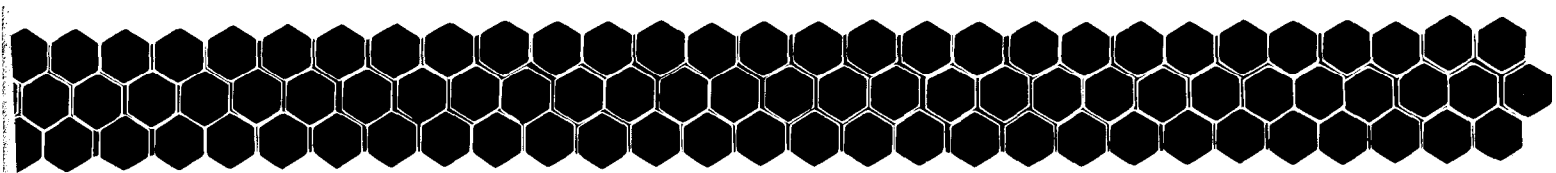
First Lessons in Beekeeping, American Bee journal, Hamilton, IL 62341

500 Answers to Bee Questions, A. I. Root Co., Medina, OH 44256

How to Keep Bees and Sell Honey, Walter T. Kelly Co., Clarkson, KY 42726

Starting Right with Bees, A. I. Root Co., Medina, OH 44256

All About Bees, Beekeeping and Honey, Walter L. Gojmerac, Drake Publishers, Inc., 801 2nd Ave., New York, NY 10017



MAGAZINES

Listed below are magazines dealing with bees. Write to them for subscription prices.

"American Bee Journal", Hamilton, IL 62341

"Gleanings in Bee Culture", Medina, OH 44256

"Canadian Beekeeping", Orono, Ontario L0B 1 M0

"Speedy Bee", Rt. 1, Box G27, Jessup, GA 31545

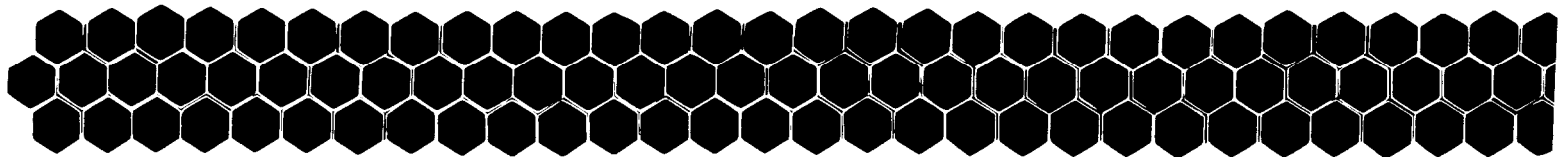
EXTENSION PUBLICATIONS

The following materials concerning beekeeping and honey handling are available from the University of Wisconsin-Extension.

If you live in Wisconsin: The publications listed below are available from your county Extension office.

If you are not a Wisconsin resident: You may wish to contact your local Extension office or land-grant university for information designed to serve the needs of beekeepers in your state or region. If, however, you wish to order publications from this list, write to the Agricultural Bulletin Building, 1535 Observatory Drive, Madison, WI 53706.

A2279	<i>The Life of the Honey Bee</i>
A2280	<i>Productive Management of Honey Bee Colonies</i>
A2491	<i>Building and Operating an Observation Bee Hive</i>
A2655	<i>Beekeeping Records</i>
A3086	<i>Protecting Wisconsin's Honey Bees from Pesticides</i>
A81L1125	<i>Beekeeping in the Midwest</i>
AZPRR161	<i>Two-Queen System of Honey Bee Colony Management</i>
AZPRR163	<i>Trapping Pollen from Honey Bee Colonies</i>
AZPRR169	<i>Overwintering of Honey Bee Colonies</i>
A80HB582	<i>Honey Bee Diseases and Other Pests</i>



FILMS

The following films are available on a *rental basis* from: Bureau of Audio Visual Instruction (BAVI), University of Wisconsin-Extension, 1327 University Avenue, P.O. Box 2093, Madison, WI 53701 (608) 262-1644. Out-of-state clients should contact BAVI for information before ordering. *For purchase information*, contact: WRS Motion Picture Labs, Inc., 210 Semple St., Pittsburgh, PA 15213.

These educational films are suitable for classroom use or to show at meetings of beekeeper clubs or associations. An experienced local beekeeper could serve as discussion leader. The films are accompanied by a teaching guide which includes a copy of the script and suggested discussion questions.

Bee Management: Fall and Winter (10 minutes)

Late Winter, Early Spring (10 minutes)

(Both titles are on one reel)

1 print from CRI (Single print price)

BAVI #1761

10 minutes each, color

Fall and Winter Fall inspection, combining and dividing colonies for overwintering, supplemental feeding, letting bees clean uncapped or wet extracted comb, clustering, proper location of honey and pollen comb, hive location, reducing hive entrance.

Late Winter, Early Spring Clustering, mid-winter inspection; proper placement of honey, pollen and brood comb; winter hive activity; symptoms and treatment of nosema; sugar feeding; mixing and feeding pollen supplement; trapping pollen (1977).

Bee Management; Honey Handling

1 print from CRI (single print price)

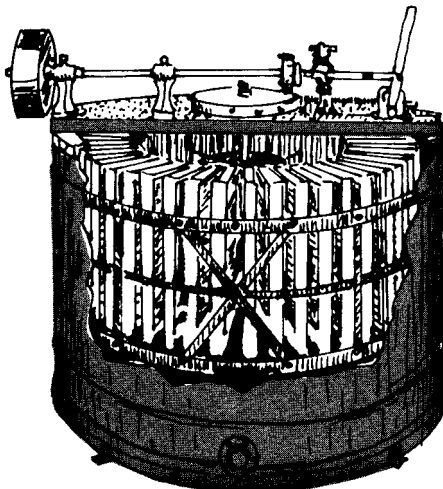
BAVI #1762

17 minutes, color

Protective equipment, when to take honey, removing full frames, uncapping, extracting, grading bottling, storage, wax recover. Intended for small scale operators but shows a commercial plant, too (1977).

Bee Equipment and Supplies Most companies will send catalogs on request.

Extractor



Dadant & Sons, Inc., P.O. Box 331, Watertown, WI 53094

Dadant & Sons (Headquarters), Hamilton, IL 62341

A.I. Root Company, Medina, OH 44256

Walter T. Kelley Company, Clarkson, KY 42726

Hubbard Apiaries, Onsted, MI 49265

Leahy Mfg. Company, Higginsville, MO 64037

Fields of Ambrosia, 6810 Watts Rd., Madison, WI 53719

Beekeeper's Sequence of Events Chart

Sequence of Events Chart

WORKER DEVELOPMENT

- Egg Hatches
- Larva
- Sealed
- Emerge

QUEEN DEVELOPMENT

- Egg Hatches
- Feed Royal Jelly
- Sealed
- Emerge
- Mate
- Egg Laying

WORKER ACTIVITIES

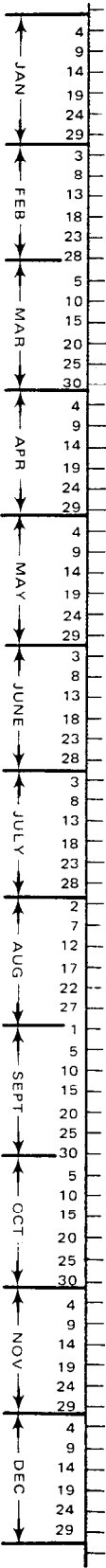
- Clean Cells Feed Larvae
- Feed Young Larvae
- Secrete Wax Build Comb
- Convert Nectar to Honey
- Gather Pollen
- Gather Nectar and Water
- Death

INSTRUCTIONS:

There are three sections (WORKER DEVELOPMENT, QUEEN DEVELOPMENT, and WORKER ACTIVITIES). To determine any stage on the chart simply move the date rule under the appropriate activity. Say that on April 9th the queen's egg should hatch. By placing the line coming from "Egg Hatches" under QUEEN DEVELOPMENT against April 9th, on the "Day of the Year Rule" one can quickly see that "Feed Royal Jelly" takes place on April 14th. "Sealed" takes place about April 19th, "Emergence" takes place about April 22nd and so on.

The same date relationship can be obtained for WORKER DEVELOPMENT and for WORKER ACTIVITIES.

Day of the Year Rule





University of Wisconsin-Extension, Cooperative Extension Programs, Gale L. VandeBerg, director, in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914 Acts of Congress; and provides equal opportunities in employment and programming including Title IX requirements.

Produced by the Department Agricultural Journalism, University of Wisconsin-Madison.

A2083 HONEY-GUIDE TO EFFICIENT PRODUCTION

\$1.75

R-09-82-2.5M-S

This publication is available from your Wisconsin county Extension office or from:

Agricultural Bulletin Building

1535 Observatory Drive

Madison, Wisconsin 53706

Phone 608-262-3346

Editors, before publicizing should contact the Agricultural Bulletin Building to determine its availability.

Walter L. Gojmerac is professor of entomology, College Agricultural and Life Sciences, University of Wisconsin-Madison. The author acknowledges the assistance of personnel of the USDA Bee Research Laboratory, Madison, Wisconsin.